

A REVISION OF THE LARGE *BARBUS*
(PISCES, CYPRINIDAE) OF EAST AND CENTRAL
AFRICA

STUDIES ON AFRICAN CYPRINIDAE
PART II

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SYNOPSIS

All the previously described species and subspecies of the large *Barbus* (the species usually described as possessing parallel striae on their scales) from east and central Africa are examined. The area under consideration is bounded in the north by the mouth of the Nile and in the south by the Zambezi system. The western boundary is the upper reaches of the Congo system adjacent to the rift valley and the eastern boundary is the coast.

It is shown that many nominal species can be synonymized when a sufficiently large series of specimens is available to show that the characters formerly used to distinguish them form a continuous series within a polytypic species. Consideration is given to the taxonomic value of these characters and their variability is demonstrated. Particularly variable are the lips, body depth and head length. This is a reflection both of eco-phenotypic factors and of allometry.

The quaternary palaeogeography of this part of Africa is considered in an attempt to elucidate the present distribution of certain species.

Two former subspecies are raised to specific rank (*Barbus longifilis* and *Barbus paucisquamatus*) and one new subspecies is described (*Barbus intermedius australis*). Two replacement names are included; *Barbus lapsus* for *Barbus babaulti* Pellegrin 1935 and *Barbus susanae* for *Barbus gregorii* Norman 1923.

INTRODUCTION

THIS revision was initiated by an unsuccessful attempt to identify satisfactorily the large *Barbus* species collected by the Sandhurst Army College Ethiopian Expeditions of 1964 and 1966. The use of the keys in Boulenger's *Catalogue of African Fresh-water Fishes* (1911-1916) showed that some species were so imprecisely defined that an individual specimen could be assigned to any one of several different species. Many of the species described by early workers on African *Barbus* species were based on one or a few poorly preserved individuals, and it is only now, when sufficient material is available, that an attempt can be made to redefine some species allowing for growth and natural variation.

Worthington (1932a) demonstrated that lip shape, formerly considered a significant specific character in the large *Barbus* species, was extremely variable. This aspect was greatly extended by Groenewald (1958) who was able to demonstrate the great range in *Barbus* species lip form engendered by the environment in certain species. In the course of this work he cast doubts upon the validity of the inclusion of certain species in the closely related genus *Varicorhinus*.

Jubb (1961, 1963, 1965, 1967a, 1968), Crass (1960) and Jackson (1961) have continued this study and have partially confirmed Worthington's (1932a) views on the variability of the large *Barbus* species. *Barbus marequensis* A. Smith has been shown by the South African workers' efforts to be a widespread and variable species.

An analogous situation exists in eastern and central Africa. Many large *Barbus* species have been described, but as more specimens were collected the boundaries between the species became obscured as new data rendered the old specific definitions untenable. New descriptions of species must, therefore, incorporate the range of intraspecific variation if the definition of the species is to have any validity and reflect the status of the populations in the field.

Several authors, e.g. Worthington (1932a), Pellegrin (1935) and Bini (1940), have described *Barbus* subspecies and varieties. The subspecies considered in this paper

conform to the definition of Mayr (1949) although it has not always been possible to conform to the '75 per cent distinguishable' convention suggested by Mayr. Geographical isolation, on its own, without any supporting morphological or colour differences is not considered sufficient justification for the establishment of subspecies. I would like to have used Mayr's definition of superspecies. I am unable to do so as I cannot prove that the species I consider to form such taxa would constitute a monophyletic assemblage and hence I use the terms supra-specific complexes or groups. This does not assume monophyly although hopefully one day it may be proved.

There are still many problems that I have been unable to consider in this work ; ecological information is only rarely available (and the effect of the environment could well be an important factor influencing the phenotypic variation) and colour patterns are based almost entirely on preserved specimens.

This revision remains, therefore, essentially that of a museum worker, but it is very possible that further information from live specimens may lead to the establishment of subspecific taxa especially in the widespread species.

There are some geographical areas that have presented many difficulties, particularly where watersheds are close together. By unfortunate quirks of geography or international politics these areas are inadequately sampled and some of my subsequent conclusions about the status of the specimens must be regarded as tentative. These problems are mentioned in the text. A lot of time was spent in trying to pin-point the localities where specimens had been collected. The localities were often given the name of the local village, but these villages were frequently only temporary settlements of nomadic tribes. Many town and village names were changed when countries were occupied or invaded and collections made at the same site under different regimes bear different locality names. Where such localities have been traced they are incorporated in the gazetteer (Appendix 2) and as much information as I can give, in physiographical details or in grid references, is included.

The limits of distribution of the species described in this paper are from the Nile in the north down to, but not including, the Zambezi system. The eastern limit is the eastern coast of Africa and the western limit is the western rift valley. Some species whose range extends to the west of the rift valley, into the Upper Congo are included, e.g. the Upper Congo species *Barbus mirabilis* is included because of its relationship with the species that live in the area covered.

The arrangement of species in the descriptive part of the text is alphabetical.

Notes on counts and measurements

The standard length (S.L.) was taken in the usual manner (see Banister 1972). The lateral line count (LL) was taken from the first pore-bearing scale behind the head to the scale lying lateral to the end of the hypurals. The body depth (D) is the maximum body depth, usually to be found just in front of the dorsal fin. The anterior limit for the head length (H) and snout length (Snt) was the premaxillary symphysis, with the premaxillae retracted. In 'rubber-lipped' fishes this measurement was only taken with difficulty. The posterior limit for the snout is the

anterior margin of the orbit. The term mouth width (MW) is a shorthand notation for the width of the lower jaw at its widest point. The pectoral fin length (Pct.) is the total length of the fin, measured in a straight line from the base of the first ray to the distal extremity of the fin. The measurement is taken in this manner because of the ease of so doing with dial calipers, which were used on all fish except the smallest when dividers were used. The caudal peduncle length (CPl) is the horizontal distance from the posterior angle of the base of the last anal fin ray to the end of the hypurals, and the caudal peduncle depth (CPd) is the least depth of that part. The interorbital width (IO) was measured as the least distance apart of the bony edges of the interorbital space. The eye diameter (I) had to be taken as the horizontal diameter of the orbit ignoring the skin around the eye. This was because in many of the more ancient specimens the skin had markedly shrivelled away from the eye and the measurements would not otherwise have been comparable with those of recently preserved fish. The dorsal spine (DSp), strictly the last unbranched ray in the dorsal fin, was measured from its base to the proximal articulation (if any were present). The reason for this was to overcome the inaccuracy caused by damage to the flexible tips and, although an arbitrary point, experience showed it to be moderately consistent. Severely damaged spines were not measured. With any measurements which were repeatable on both sides of the fish (e.g. anterior barbel, Ab, or posterior barbel, Pb), the larger was taken except in a few cases when gross deformity was obvious.

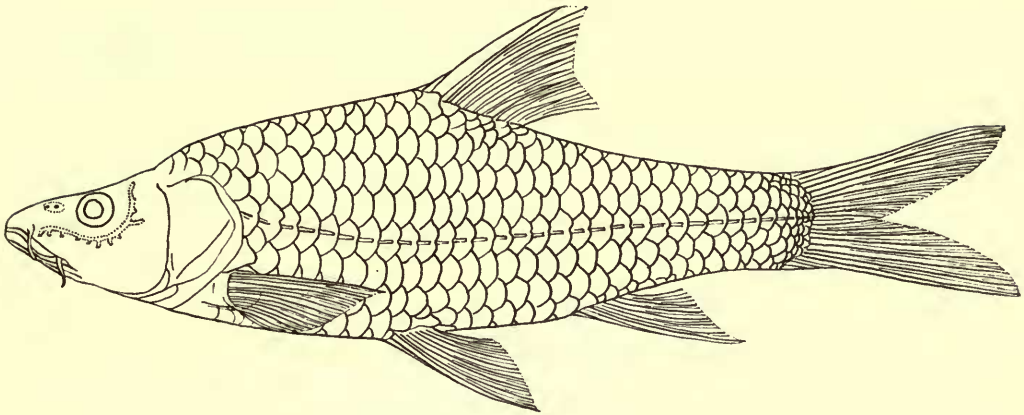
The majority of measurements were taken to the nearest millimetre. The exceptions were some measurements made on small fishes; these were taken to the nearest half millimetre. The limits of accuracy do not justify calculations taken to more than one place of decimals. The mean is symbolised by \bar{x} , the standard deviation by s.d., the standard error by s.e. and the mode by m. The height of a pharyngeal tooth is taken as the parameter at 90 degrees to the plane of the pharyngeal bone, the length of the pharyngeal tooth is the parameter of a transverse section of the tooth in the plane of the anterior edentulous process and the width of the tooth is the parameter at 90 degrees to the length. The code letters for the museums from whose collections the specimens came are listed at the start of Appendix 4.

All the drawings of the pharyngeal bones show 1) the bone directly from above with the bone lying flat on its edentulous surface and 2) an occlusal view of the inner row of teeth with the bone at 90 degrees to the position in 1), i.e. drawn from above with the bone mounted vertically on its posterior edentulous process. For convenience these are referred to in the text and figure captions as, respectively, the dorsal and lateral views.

Barbus acuticeps Matthes 1959

Barbus acuticeps Matthes, 1959, *Folia scient. Afr. cent.* 5 (3) : 62; Matthes, 1962, *Annls Mus. r. Afr. cent. Ser. 8vo* 111 (2) : 81, pl. 1, fig. b.

HOLOTYPE. A fish of 210 mm S.L. from the Nyawarongo river, Lake Rugwero, Rwanda. Specimen no. M.A.C.T. 130313.

FIG. 1. *Barbus acuticeps* from Matthes 1962.

DESCRIPTION. The description is based on nine specimens, the holotype, four paratypes (I30310-12, I30314) of S.L. 43 mm, 121 mm, 92 mm and 202 mm respectively, and four other specimens M.A.C.T. I2910 (S.L. 131 mm), I3045-6 (119 and 116 mm S.L.) and I72421 (242 mm S.L.).

My standard length measurements are consistently shorter than those of Matthes (1962). I attribute this to different concepts of standard length.

	n	\bar{x}	s.d.	s.e.	range
L					43 -242 mm
D	9	27.8	4.1	1.3	23.6-33.7
H	9	28.7	3.5	1.2	24.8-35.6
I	9	6.3	1.3	0.5	4.3- 9.3
IO	9	7.1	1.6	0.5	4.7-10.4
MW	8	5.8	1.3	0.5	4.5- 7.9
Pct	8	21.7	2.0	0.7	19.5-25.8
CPl	9	17.6	1.7	0.6	15.2-20.6
CPd	9	11.4	1.5	0.5	9.3-13.7
Snt	8	8.3	1.2	0.4	6.4-10.4
Ab	8	4.8	2.1	0.8	2.2- 6.9
Pb	8	5.6	2.3	0.8	2.9- 8.6

All measurements are expressed as percentages of the standard length.

The dorsal profile of the head is concave and a pronounced nuchal hump is present. The snout is pointed and the mouth slopes upwards. Otherwise the body and head shape resembles that of *Barbus altianalis* (*sensu lato*) and *Barbus ruasae*.

Squamation. It was not possible to obtain scale counts for the two smallest specimens. The scales have parallel striae and there are 27 (f.3), 28 (f.1), 29 (f.2) or 30 (f.1) scales in the lateral line. Between the dorsal mid-line and the lateral line there are 4.5 (f.5) or 5.5 (f.2) scale rows. In only two specimens was it possible to count the number of scale rows between the lateral line and the ventral mid-line,

in both there are 5.5 rows. Between the lateral line and the base of the pelvic fin there are 2 (f.2), 2.5 (f.2) or 3 (f.1) scale rows. There are 12 scales encircling the caudal peduncle.

Dorsal fin. There are 8 (f.5) or 9 (f.3) branched rays. The fourth unbranched ray is ossified into a smooth, straight spine ($\bar{x} = 22.3$; s.d. = 2.9; s.e. = 1.0; range 17.4–26.7). There is no sheath of scales at the base of the dorsal fin. The dorsal fin origin is slightly behind that of the pelvic fins. The *anal fin* has three simple rays and five branched rays.

Gill rakers. In five specimens examined, three had eight gill rakers on the lower limb of the first gill arch, the other two had ten and eleven.

Pharyngeal bones and teeth. I have not been able to study the pharyngeal bones but they were described by Matthes (1962) as 'Falciformes, non soudés, attachés l'un à l'autre par une symphyse ligamenteuse. Ils sont peu élargis et les branches montantes sont comprimées et assez grêles. Dents pharyngiennes obliquement tronquées et légèrement excavées, avec une pointe antérieure recourbée vers l'arrière, en 3 rangées au nombre de 2, 3, 5-5, 3, 2, les 2me et 3me dents de la rangée interne un peu plus fortes.'

Coloration. Described by Matthes (1962) as completely silvery with pearly reflections when alive. The operculum is yellowish with metallic glints, the eye is yellowish, the pupil ringed with gold. The fins are clear, yellowish; the dorsal and caudal are greyish, yellowish and salmon-pink.

DISTRIBUTION. Four of the specimens came from the Nyawarongo river (to the north of Lake Rugwero), the fifth specimen in the type series came from the falls of Rusumu on the Kagera (Rwanda). The other specimens came from Lake Ihema, Kagera; the Nyabugogo river (an affluent of the Lusine river, Burundi) and from Matale (? Burundi).

DIAGNOSIS AND AFFINITIES. *Barbus acuticeps* is dubiously distinct from *Barbus altianalis*. The principal differences between *Barbus acuticeps* and *Barbus altianalis* are 1) the concave dorsal profile of the head and the nuchal hump of the former species, 2) the antero-dorsal gape of the mouth of the former species which contrasts with the, usually, subterminal mouth in *Barbus altianalis*, 3) fewer gill rakers in *Barbus acuticeps* (8–11) compared with 10–14 (most frequently 11–13) in *Barbus altianalis*, 4) slightly fewer scales in the lateral line series in *Barbus acuticeps* (27–30) compared with 28–36 (most frequently 30–34) in *Barbus altianalis*, 5) a longer dorsal fin spine in *Barbus acuticeps* ($\bar{x} = 22.3$, range 17.4–26.7) compared with $\bar{x} = 16.9$, range 9.0–30.4, in *Barbus altianalis*.

It must be remembered that *Barbus acuticeps* is known from very few specimens and that more are necessary to confirm whether or not its continued separation from *Barbus altianalis* is justified.

Barbus ruasae (p. 109) also from Rwanda to some extent resembles *Barbus acuticeps* in general appearance but is readily separable on the lower number of scales in the lateral line series [25 (f.9), 26 (f.1)]. The pharyngeal teeth of *Barbus acuticeps* are less molariform than those of *Barbus ruasae*, but this could be the

result of diet. *Barbus ruasae* does not have a mouth opening antero-dorsally. *Barbus acuticeps* is considered here to belong to the *Barbus intermedius* group (see p. 128).

***Barbus alluaudi* Pellegrin, 1909**

Barbus alluaudi Pellegrin, 1909, *Bull. Soc. zool. Fr.* **34** : 155 ; Pellegrin, 1910, *Mem. Soc. zool. Fr.* **22** : 287, pl. 14, fig. 2 ; Banister, 1972, *Bull. Br. Mus. nat. Hist. (Zool.)* **24** (5) : 261-290.

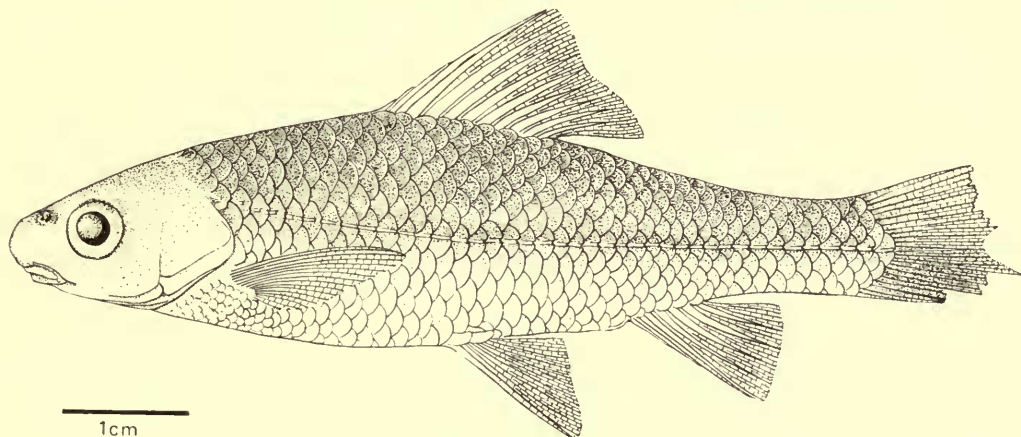


FIG. 2. *Barbus alluaudi* Holotype.

This specific name has, I believe, been given to hybrids between *Barbus somereni* and *Varicorhinus ruwenzorii* [Banister (1972)].

***Barbus altianalis* Boulenger, 1900**

Barbus altianalis Blgr., 1900, *Ann. Mag. nat. Hist. (7)* **6** : 479 ; Blgr., 1901, *Trans. zool. Soc. London*, **16** : 144, pl. 13, fig. 1 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 36 ; Norman, 1925, *Occ. Pap. Boston Soc. nat. Hist.* **5** : 189.

Barbus altianalis altianalis : Worthington, 1932, *J. Linn. Soc. (Zool.)* **38** (258) : 124-127 (Lake Kivu and Ruzizi river specimens) ; Poll, 1953, *Result. scient. Explor. hydrobiol. Lac Tanganyika* (3) **5A** : 88.

Barbus altianalis radcliffii : Worthington, 1932, *ibid.* : 124-127 (Lake Victoria specimens).

Barbus altianalis eduardianus : Worthington, 1932, *ibid.* : 124-127 (Lakes Edward and George specimens).

Barbus altianalis var. labiosa Pellegrin, 1935, *Revue Zool. Bot. afr.* **28** (3) : 376-385 (only the holotype, from Lake Kivu).

Barbus (Labeobarbus) nedgia : Hilgendorf, 1888, *Sber. Ges. naturf. Freunde Berl.* : 88 (from Lake Victoria, misidentification, not *Barbus nedgia* Rüppell ; *vide* Blgr., 1911).

Barbus eduardianus Blgr., 1901, *Ann. Mag. nat. Hist. (7)* **8** : 12 ; Blgr., 1907, *Fish Nile* : 230, pl. 43, fig. 2.

Barbus fergussonii Blgr., 1901, *Ann. Mag. nat. Hist. (7)* **8** : 12 ; Blgr., 1907, *Fish Nile* : 230, pl. 43, fig. 1.

Barbus radcliffii Blgr., 1903, *Ann. Mag. nat. Hist. (7)* **12** : 218 ; Blgr., 1907, *Fish Nile* : 212, pl. 37, fig. 1.

- Barbus marequensis* : Pellegrin, 1904, *Mem. Soc. zool. Fr.* **17** : 17 (misidentification, not *Barbus marequensis* Smith, specimen from Kavirondo, Lake Victoria, *vide* Blgr., 1911).
- Barbus lobogenys* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 435 ; Blgr., 1907, *Fish Nile* : 210, pl. 36, fig. 1.
- Barbus bayoni* Blgr., 1911, *Annali Mus. civ. Stor. nat. Giacomo Doria* (3) **5** : 77.
- Barbus kivuensis* Pappenheim, 1914, *Wiss. Ergebn. dt. ZentAfr. Exped.* Zool. (3) **5** : 237.
- Barbus gregorii* : Blgr., 1916, *Cat. Afr. Fish* **4** : 230 (only the specimens from the Malawa river).
- Barbus pietschmanni* Lohberger, 1929, *Anz. Akad. Wiss. Wien* **66** : 92-94.
- Barbus hollyi* Lohberger, 1929, *Anz. Akad. Wiss. Wien* **66** : 92-94.
- Barbus obesus* Worthington, 1929, *Proc. zool. Soc. Lond.* (3) : 433.
- Barbus kiogae* Worthington, 1929, *Proc. zool. Soc. Lond.* (3) : 434.
- Barbus longirostris* Worthington, 1929, *Proc. zool. Soc. Lond.* (3) : 435.

NOTES ON THE SYNONYMY. *Barbus altianalis* is a widespread species occupying three isolated areas. The fish of each of these areas, although in morphometric characters scarcely different modally from one another, were given subspecific status by Worthington (1932a).

Barbus altianalis was first described from two fish from Lake Kivu and one from the Ruzizi river. All are large specimens ; the smallest (from the Ruzizi) has a S.L. of 306 mm while the other two are 331 and 406 mm.

Barbus eduardianus was described from one large fish from Lake Edward and *Barbus fergussonii* from two small fishes from the same lake. The latter two specimens have unusually shallow bodies when compared with equal-sized specimens even from the same waters.

Barbus radcliffii was based on a skin from Lake Victoria. *Barbus lobogenys* was based on two 'rubber-lipped' specimens from Lake Victoria. *Barbus bayoni* was described from a very large fish (S.L. 640 mm) from near Jinja on Lake Victoria. *Barbus pietschmanni* and *Barbus hollyi*, both from Lake Victoria, were based respectively on one and two specimens.

The holotype and sole example of *Barbus obesus* from Lake Kioga (fig. 3) is a fat, deep-bodied fish with a low number of lateral line scales (28). The scales are slightly lobed and the specimen gives the impression of a rather deformed individual. The two syntypes of *Barbus longirostris* (fig. 4) from the same locality are large specimens (388 and 410 mm S.L.) with shallow bodies and heads longer than the mean for the species. They are linked with more typical *Barbus altianalis* by members of the type series of *Barbus kiogae*. No morphometric or meristic way can be found for separating the populations from Lake Kioga from those of Lake Victoria. Large fish from Lake Victoria not infrequently approximate to the facies of *Barbus longirostris* and *Barbus kiogae* (P. H. Greenwood : pers. comm.): The description of the holotype of *Barbus kivuensis* differs hardly at all from that of *Barbus altianalis* from the same lake.

Norman (1925) commented that the specimens of *Barbus altianalis* from Lake Edward, collected by Dr John Phillips, were identical with *Barbus radcliffii* from Lake Victoria.

Worthington (1932a) was able to gather together sufficient material to realize that a single species is found in the three areas, *Barbus altianalis altianalis* from Lake Kivu and the Ruzizi river ; *Barbus altianalis radcliffii* from Lake Victoria and the

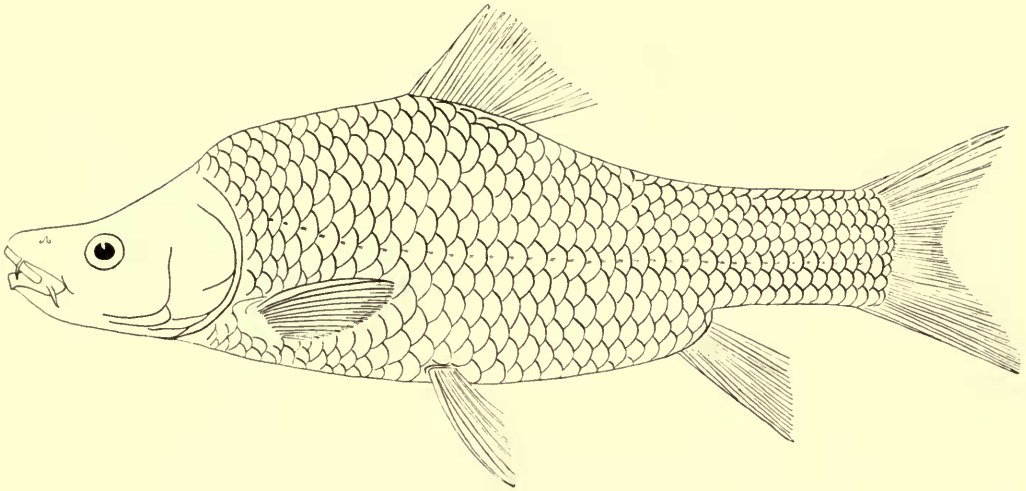


FIG. 3. *Barbus altianalis* (Holotype of *Barbus obesus* re-drawn from Worthington 1929).

Victoria Nile; and *Barbus altianalis eduardianus* from Lakes Edward and George and the Kazinga channel.

Boulenger's *Barbus radcliffii*, *Barbus lobogenys* and *Barbus bayoni* were synonymized by Worthington (1932a) in *Barbus altianalis radcliffii*, and *Barbus eduardianus* and *Barbus fergussonii* in *Barbus altianalis eduardianus*. An important conclusion of Worthington's work was the realization that *Barbus* species can exhibit remarkable intraspecific variation, particularly with regard to the development of the lips and he suggested that further extensive synonymizing might be necessary when larger samples became available. However, he did not synonymize the species he described from Lake Kioga because with the material at his disposal they remained apparently distinct. Scatter diagrams comparing body depth and head length of the Lake Victoria and Lake Kioga populations are shown below (figs. 6 and 7). Pellegrin (1933, 1935) described several varieties of *Barbus altianalis* from Kivu region: only one of these is considered here as belonging to this species (for the others see under *Barbus caudovittatus*, *Barbus paucisquamatus* and *Barbus longifilis*). A slight element of confusion was introduced by Pellegrin's use of 'Région du Kivu'; this is not always the Lake Kivu basin but in some cases refers to sites in the Congo system.

Greenwood (1966) synonymized *Barbus pietschmanni* and *Barbus hollyi* with *Barbus altianalis radcliffii*.

I am retaining Worthington's three subspecies, certainly on geographical grounds but also because of the consistent colour differences between the *Barbus* subspecies of Lake Victoria and those of Lake Edward-George. Dr P. H. Greenwood (pers. comm.) has noted that specimens of *Barbus altianalis eduardianus* of over 100 mm S.L. from Lake Edward-George have pink caudal fins whereas those of Lake Victoria never do. I have no information about the specimens from Lake Kivu.

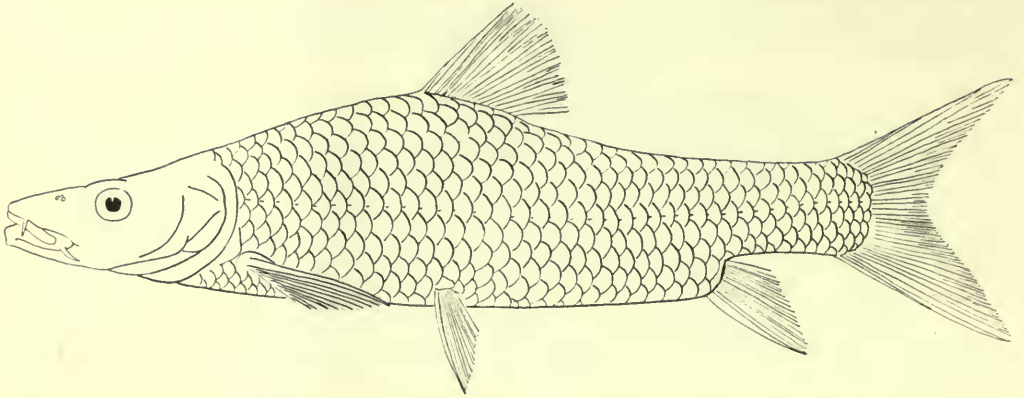


FIG. 4. *Barbus altianalis* (figured specimen of *Barbus longirostris*, re-drawn from Worthington 1929).

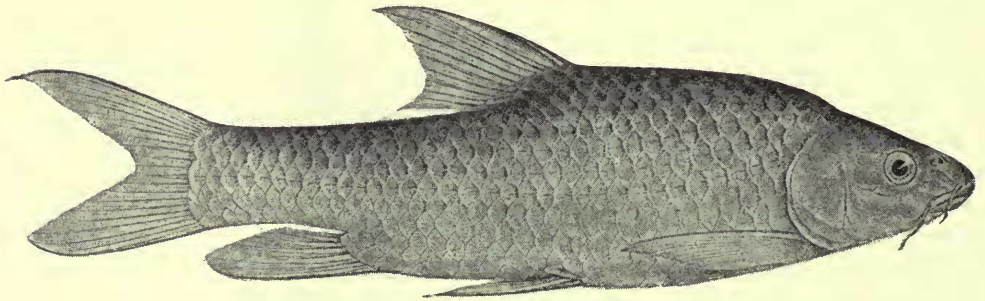


FIG. 5. *Barbus altianalis altianalis* (Holotype from Boulenger 1911a).

LECTOTYPE. A fish of 331 mm S.L. from Lake Kivu (one of the three in Boulenger's type series). B.M. (N.H.) Reg. No. 1906.9.6 : 13.

DESCRIPTION. The description is based on a total of 213 specimens ; 15 of these are from Lake Kivu and the Ruzizi river (size range 46–410 mm S.L.), 130 are from Lakes Edward and George, the Kazinga channel and Lake George feeder streams (size range 68–436 mm) and 68 are from Lakes Victoria and Kioga (size range 99–640 mm). The combined morphometric data for all three populations are as follows, and include all the holotypes except for *Barbus pietschmanni* and *Barbus hollyi*.

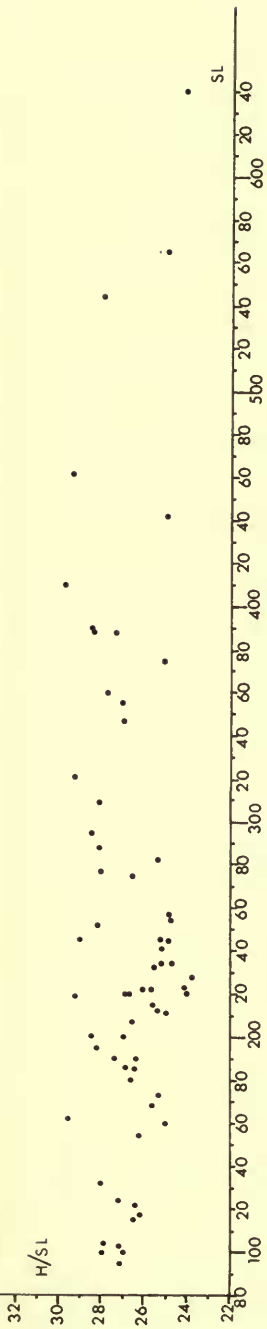


FIG. 6. Scatter diagram of the head length as a percentage of the standard length against the standard length for the Lakes Victoria and Kioga populations of *Barbus altianalis radcliffei*.

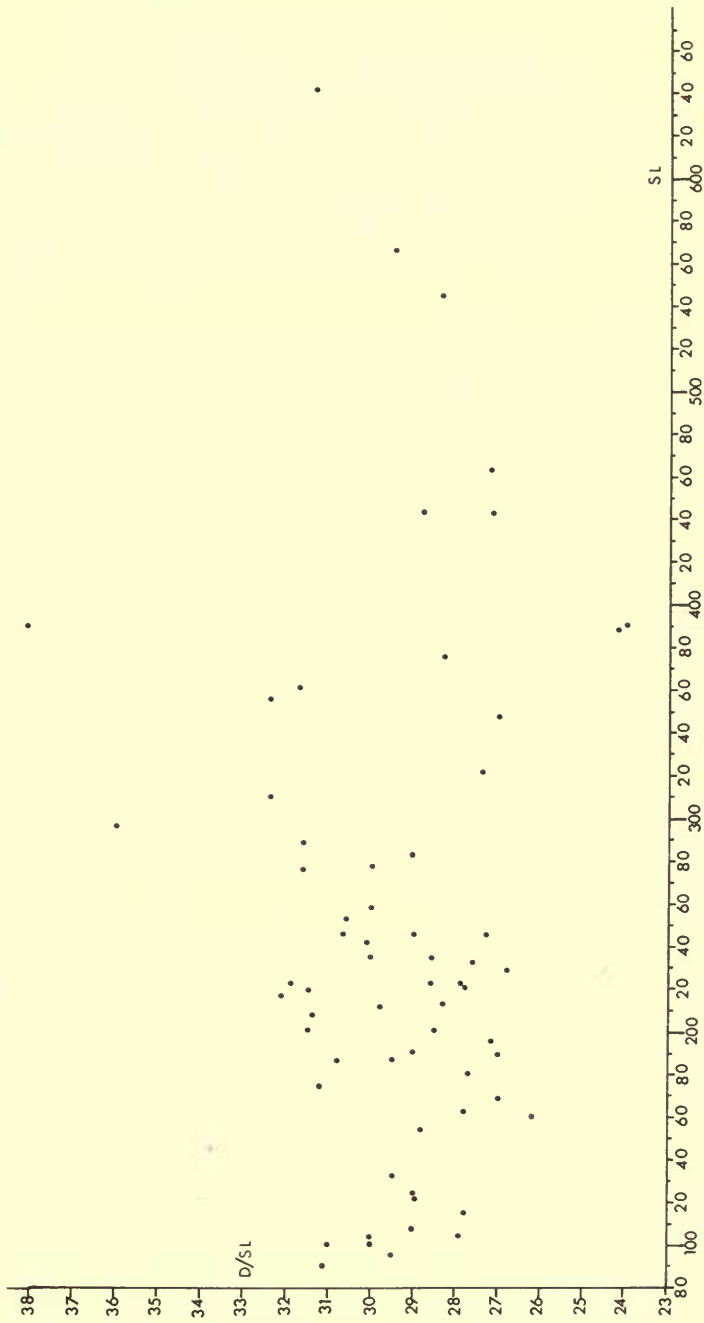


FIG. 7. Scatter diagram of the body depth as a percentage of the standard length against the standard length for the Lakes Victoria and Kioga populations of *Barbus altianalis radcliffei*.

	\bar{x}	s.d.	s.e.	range
L				46 -640 mm
D	29.4	2.4	0.4	22.4-37.4
H	26.1	1.6	0.1	22.5-31.4
I	7.6	1.0	0.1	4.1-11.5
IO	8.4	1.0	0.7	6.4-11.2
MW	6.2	0.9	0.1	4.7- 9.5
Pct	21.8	1.4	0.1	17.5-25.0
CPI	16.9	1.4	0.1	13.1-19.8
CPd	12.0	0.9	0.1	9.5-16.2
Snt	8.3	0.8	0.1	5.8-10.9
Ab	4.3	1.1	0.1	2.1-11.6
Pb	5.4	1.3	0.1	2.3-12.4

The body shape is extremely variable, especially in large fish. This is more noticeable in Lake Kioga than elsewhere and a graph showing the variation in body depth to length can be seen in fig. 7. It is possible that the deeper-bodied specimens are females but most of the specimens that I have seen had been gutted (see below).

The mouth is sub-terminal and usually in the shape of a narrow horse-shoe. 'Rubber-lipped' forms have been found (e.g. the holotype of *Barbus lobogenys* - see fig. 8). The snout tends to overhang the mouth in fishes of medium size.

Dorsal fin. The dorsal fin has four unbranched rays. The last unbranched ray is enlarged into a smooth, straight or slightly curved, well-ossified spine with articulations only at the tip. The dorsal fin spine is negatively allometric; $\bar{x} = 16.9$, s.d. = 3.2, s.e. = 0.2, range = 9.0-30.4 (percentage of the S.L.) for the whole sample (fig. 9). This range is too large to be useful as a diagnostic character but it can be seen from fig. 9 that there are three convenient size ranges of fishes which can be treated separately: 0-170 mm, $\bar{x} = 19.2$, s.d. = 3.0, s.e. = 0.3, range = 13.7-30.4; 171-250 mm S.L., $\bar{x} = 16.8$, s.d. = 1.7, s.e. = 0.2, range = 12.8-20.6; above 251 mm S.L., $\bar{x} = 13.4$, s.d. = 2.3, s.e. = 0.3, range = 9.9-20.2. It is interesting to note that these three S.L. ranges are the same for *Barbus intermedius* (see p. 68).

The branched rays number 8 (f.30), 9 (f.177) or 10 (f.6). The relative proportions of fishes with 8, 9 or 10 rays does not differ detectably in the three subspecies. The dorsal fin origin is situated in front (rare) or more commonly directly above or just behind the vertical from the origin of the pelvic fins.

The *anal fin* has three simple rays and five branched rays; the unbranched rays, although thickened, are much more flexible than those in the dorsal fin.

Pharyngeal bones and teeth. The pharyngeal teeth almost always number 2.3.5. - 5.3.2. The one exception to this is a specimen from Lake George, S.L. 208 mm B.M. (N.H.) Reg. No. 1971.8.11: 33-39 which is abnormal and the teeth number 1.1.2.3.5. - 5.3.2.1.

The pharyngeal bones may vary in thickness in fishes of the same size. The variability in the length and thickness of the bones and the teeth is a striking feature of this species and *Barbus intermedius*. Both species have remarkably variable body forms and there appears to be a loose correlation between body depth and the

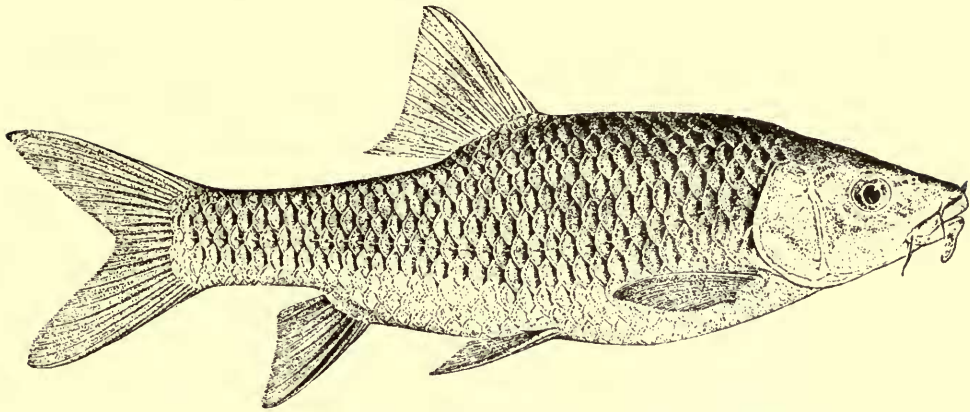


FIG. 8. *Barbus altianalis radcliffii* (Type of *Barbus lobogenys* from Boulenger 1911a).

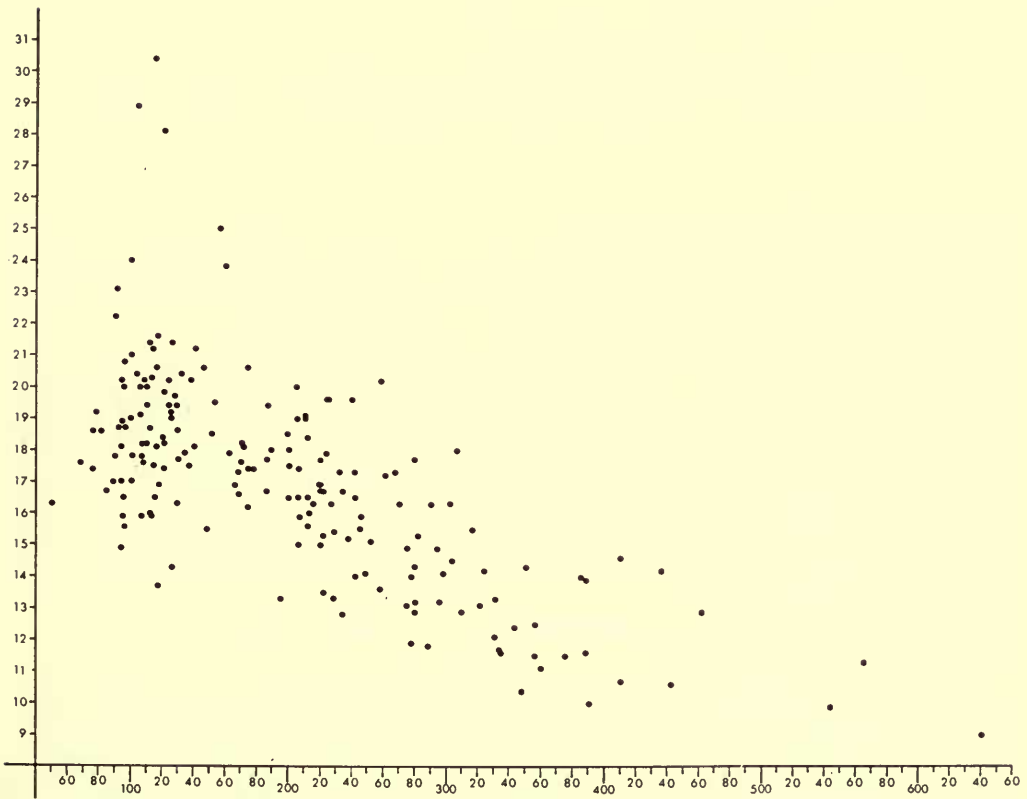


FIG. 9. Scatter diagram of the dorsal spine length as a percentage of the standard length against the standard length for *Barbus altianalis*. (= *Barbus altianalis altianalis*, *Barbus altianalis radcliffii*, *Barbus altianalis eduardianus*).

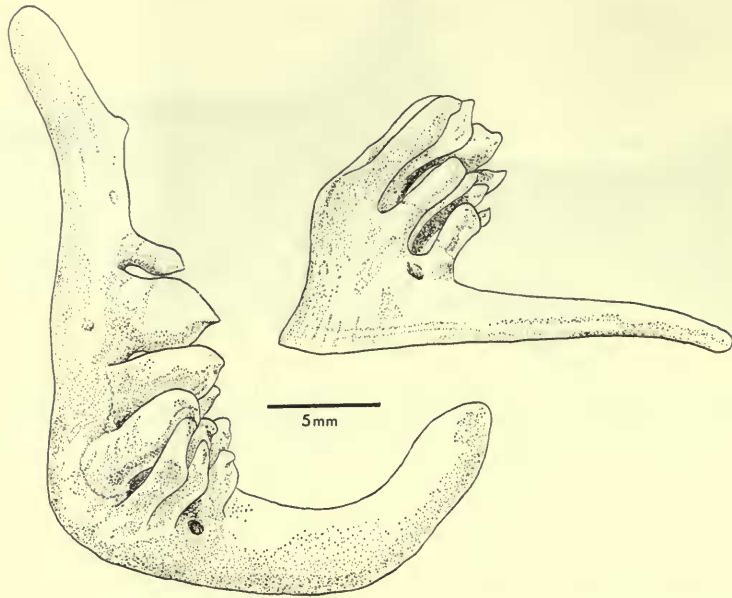


FIG. 10. Dorsal and lateral views of the left pharyngeal bone of the holotype of *Barbus altianalis altianalis*.

tip-to-tip length of the pharyngeal bone. The very deep-bodied specimen of *Barbus altianalis* (i.e. *Barbus obesus*) and the deep-bodied *Barbus intermedius* (i.e. *Barbus surkis*) both have pharyngeal bones that are very much longer and stouter than those of less deep-bodied fishes of the same standard length.

A series of ten fishes from Lake Victoria and ten from Lakes Edward and George were examined to see what relationship was present between the length or depth of the body and the size of the pharyngeal bone. The results from this small trial sample must be used with considerable restraint but using the coefficient of variation technique there are indications that the length of the pharyngeal bone is closely related to the depth of the body. I do not want to pursue this matter any further or in any detail but simply mention the possibility that this correlation is worth further study.

The pharyngeal bone of a long-headed specimen (*Barbus longirostris*) is shown in fig. 12.

Diet presumably must have an effect upon the stoutness of the pharyngeal bones and upon the shape of the teeth. The stomach of the deep-bodied *Barbus intermedius* mentioned above (and p. 69) is full of gastropod mollusc shells, which, if this were its normal diet, could explain the molariform teeth and the stout bone as having been developed as a result of breaking open strong shells. Regrettably, the stomach contents of the deep-bodied *Barbus altianalis* were unidentifiable and there were no traces at all of shells. The extent to which diet affects the pharyngeal teeth

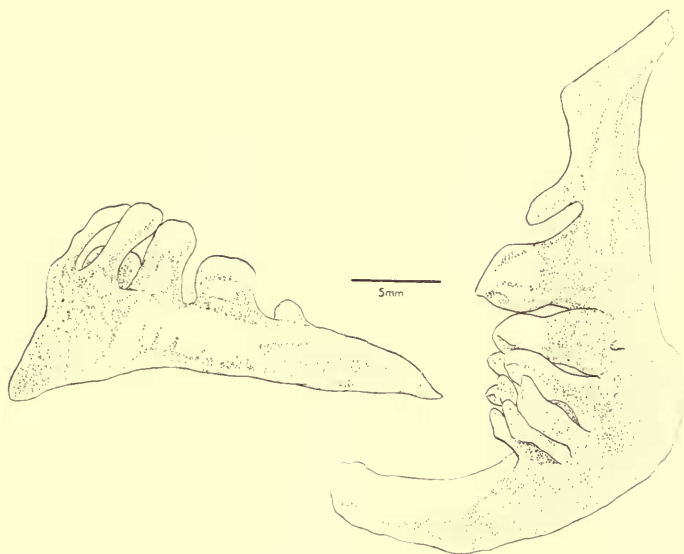


FIG. 11. Dorsal and lateral views of the left pharyngeal bone of a specimen of *Barbus altianalis eduardianus*.

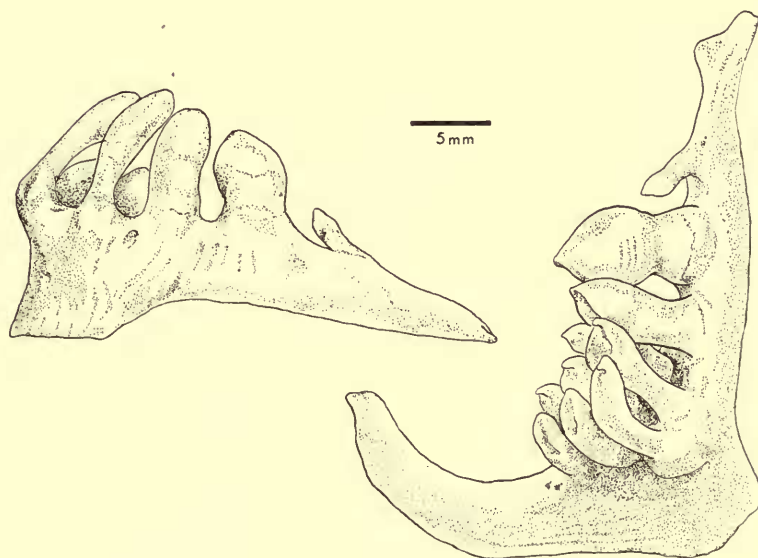


FIG. 12. Dorsal and lateral views of the left pharyngeal bone of *Barbus altianalis radcliffii* (one of the types of *Barbus longirostris* S.L. 410 mm).



FIG. 13. A series of pharyngeal bones from specimens of *Barbus altianalis eduardianus*, to show the variation in shape with the growth of the fish. The standard lengths (mm) of the specimens are: A = 90; B = 100; C = 101; D = 125; E = 141; F = 171; G = 205; H = 227; I = 258; J = 330.



FIG. 14. A series of pharyngeal bones from specimens of *Barbus altianalis radcliffii*. Compare with the series opposite. Standard lengths (mm) of the specimens are: A = 84; B = 102; C = 118; D = 125; E = 145; F = 160; G = 197; H = 228; I = 255; J = 343; K = 410; L = 388. K is from the holotype of *Barbus longirostris*; L is from the holotype of *Barbus obesus*.

in these species cannot be determined at the moment, but further considerations are mentioned on p. 127.

Consistent differences were noted in the pharyngeal bones and teeth of specimens of *Barbus altianalis radcliffi* and *Barbus altianalis eduardianus* of the same size (figs. 13 and 14). The pharyngeal bones of *Barbus altianalis radcliffi* are consistently stouter than those of *Barbus altianalis eduardianus* and the angle of the anterior process is different.

About 15 per cent of the pharyngeal bones examined had a molariform second tooth in the inner row. This phenomenon is as common in Lake Victoria as it is in Lakes Edward and George and is apparently unrelated to size, the molariform tooth being found in a specimen of only 121 mm S.L.

The change in the shape of the pharyngeal bones and teeth with the increase in the size of the fish can be seen in figs. 13 and 14. These should be compared with the series of pharyngeal bones of *Barbus bynni* (fig. 19) – a species with a less variable body form.

Cyprinid pharyngeal bones and teeth have frequently been considered good characters for distinguishing species. The value of this character must now be reconsidered in the light of the observed variability of these characters in *Barbus altianalis*. There are two possible interpretations of the evidence: that either the degree of variation in the pharyngeal bones and teeth has not been fully realized and that it is a dubious character at the species level; or that certain species only have variable pharyngeal bones and teeth and that for these species the very variation is a good character. Insufficient evidence is available at the moment to expand the arguments for either of the two interpretations.

Squamation. The lateral line follows a gentle curve. There are from 28 to 36 scales in the lateral line; 28 (f.3), 29 (f.6), 30 (f.20), 31 (f.41), 32 (f.57), 33 (f.41), 34 (f.26), 35 (f.9), 36 (f.2) (fig. 59). The number of scales in the lateral line series could not be counted on all the specimens. There are 6.5 (less frequently 5.5, rarely 4.5) scales between the dorsal mid-line and the lateral line and 5.5 (less frequently 6.5, rarely 4.5) scales between the lateral line and the ventral mid-line. The number of scale rows between the lateral line and the origin of the pelvic fin varies, between 2 and 3.5. The number of scales around the caudal peduncle varies from 12 to 14.

Gill rakers. There are from 10 to 14 (most frequently 11–13) gill rakers on the lower limb of the first gill arch in all three subspecies.

Coloration. Generally the body colour in live fish is from a silvery-grey to a bronzy-green, the scales frequently having dark bases, the operculum slightly bronzy. In fresh specimens from Lake George the pectoral fins are faintly pink with a darker posterior half. The pelvics are grey suffused with pink; the anal fin membrane is dark at the base. The caudal fin is salmon-pink with a dark posterior edge in specimens of over 100 mm S.L. from Lakes Edward and George. This is a diagnostic character separating the Lake Victoria and the Lakes Edward and George subspecies.

Barbus altianalis altianalis Boulenger

A general description of the species is given on p. 12. For comparative purposes morphometric data of the 15 specimens (S.L. 46-410 mm) from Lake Kivu and the Ruzizi river are given below.

	\bar{x}	s.d.	s.e.	range
L				49 - 410 mm
D	26.9	2.3	0.6	22.6-30.3
H	25.6	1.4	0.4	23.4-28.0
I	7.0	2.1	0.5	4.5-10.2
IO	7.8	1.2	0.3	6.6-10.3
MW	6.0	0.8	0.2	4.6- 7.7
Pct	22.0	1.1	0.3	20.2-23.8
CPl	15.6	1.3	0.3	13.1-17.6
CPd	11.0	0.7	0.2	10.1-11.4
Snt	8.5	0.9	0.2	7.3-10.1
Ab	4.5	1.1	0.3	2.4- 6.6
Pb	5.9	1.2	0.3	4.6- 8.3
DSp	16.9	2.3	0.6	13.3-23.1

Lateral line count 30 (f.5) ; 31 (f.2) ; 32 (f.3) ; 33 (f.3) ; 34 (f.2).

Barbus altianalis eduardianus Boulenger

HOLOTYPE. A fish of 371 mm S.L. B.M. (N.H.) Reg. No. 1906.9.7 : 41 from Lake Edward, Uganda.

DESCRIPTION. The description is based on 130 specimens. A general description is given above. The morphometric data in detail are as follows.

	\bar{x}	s.d.	s.e.	range
L				68 - 436 mm
D	29.6	2.1	0.2	22.4-37.0
H	25.8	1.6	0.1	22.5-31.4
I	8.0	1.5	0.1	4.1-11.5
IO	8.1	0.9	0.1	6.4-10.8
MW	6.0	0.7	0.1	4.4- 8.3
Pct	22.1	1.3	0.1	18.8-25.0
CPl	17.1	1.2	0.1	14.4-19.7
CPd	12.4	0.9	0.1	10.1-16.2
Snt	8.1	0.7	0.1	5.8-10.1
Ab	4.2	0.7	0.1	2.2- 6.4
Pb	5.4	0.9	0.1	3.7- 7.3
DSp	17.5	2.4	0.2	11.7-24.0

Lateral line count 28 (f.1), 29 (f.5), 30 (f.9), 31 (f.21), 32 (f.39), 33 (f.22), 34 (f.17) 35 (f.6), 36 (f.2). The lateral line scales could not be counted on all the specimens examined.

It is perhaps unwise to compare this sample with the much smaller sample from Lake Kivu but the general agreement in mean values indicates that the two populations are extremely similar.

Barbus altianalis radcliffii Boulenger

HOLOTYPE. A skin of 530 mm S.L. B.M. (N.H.) Reg. No. 1904.5.19: 13 from Lake Victoria.

DESCRIPTION. The description is based on 68 specimens (S.L. 90-640 mm). A general description is given above. The morphometric data in detail are given below.

	\bar{x}	s.d.	s.e.	range
L				90 -640 mm
D	29.6	2.7	0.3	24.0-37.4
H	26.7	1.7	0.2	23.8-29.8
I	7.0	1.1	0.1	4.1- 9.3
IO	9.0	1.0	0.1	7.5-11.2
MW	6.6	1.0	0.1	4.7- 9.5
Pct	21.3	1.6	0.2	17.5-24.6
CPl	16.8	1.7	0.2	13.2-19.8
CPd	11.7	0.9	0.1	9.5-13.9
Snt	8.7	0.7	0.1	7.5-10.9
Ab	4.5	1.6	0.2	2.1-11.6
Pb	5.3	1.9	0.2	2.3-12.4
DSP	15.9	4.2	0.5	9.0-30.4

Lateral line count 28 (f.2), 29 (f.1), 30 (f.6), 31 (f.18), 32 (f.15), 33 (f.16), 34 (f.7), 35 (f.3).

The mean values for the measurements taken differ little from those of the other two populations. The absence of the red/pink caudal fin in *Barbus altianalis radcliffii* has been mentioned above.

DISTRIBUTION. *Barbus altianalis* is found in Lake Kivu and the adjacent part of the Ruzizi river, Lake Victoria including the Lake Kioga basin and Lakes Edward and George. Although Lake Victoria and Lakes Edward and George are still connected, migration along the connecting waterways is not easy at the moment. The presence of *Barbus altianalis* in Lake Kivu, which is isolated from Lake Victoria and Lakes Edward and George, and its absence from Lake Albert are facts which must be explained. A certain amount is known about the geological history of the lakes and I have attempted to assemble and correlate recorded events from each lake and to try to explain the distribution of this species.

During the early Pliocene, the region now occupied by Lake Victoria was drained to the west by the upper tributaries of the Congo system (Cooke 1958). This drainage system persisted well into the Pleistocene (Kendall 1969). Stages in the formation of the western rift valley interrupted this flow and the upwarp of the

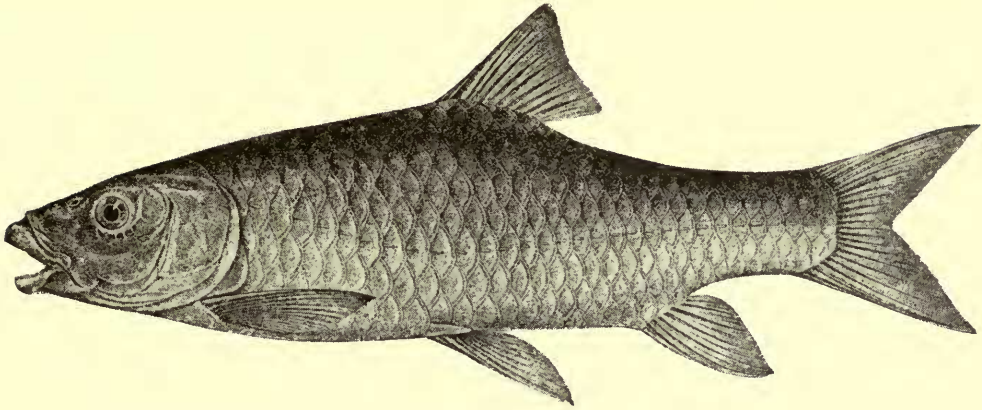


FIG. 15. *Barbus altianalis radcliffii* (the type of *Barbus radcliffii*, from Boulenger 1911a).

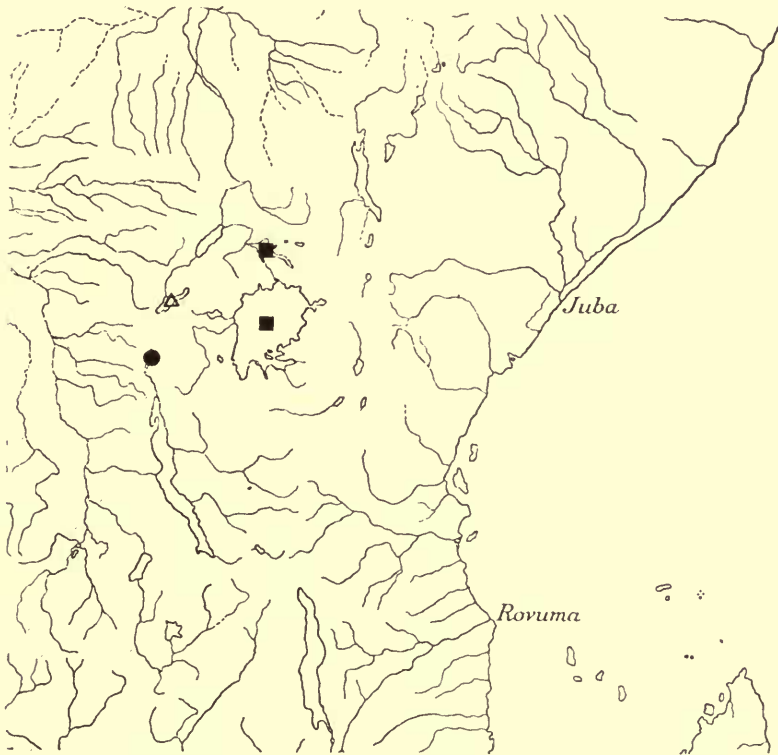


FIG. 16. Map of the distribution of the three subspecies of *Barbus altianalis*: *B. altianalis altianalis* = ●, *B. altianalis eduardianus* = △, *B. altianalis radcliffii* = ■.

eastern shoulder of the rift caused the rivers to reverse their flow and pond-up in the shallow depression between the eastern and western rifts. This led to the formation of the present-day Lake Victoria which Temple (1969) dates from the mid-Pleistocene. Tectonic movements have altered the lake since its original formation.

Lacustrine deposits at Nsongezi in the Kagera valley (to the west of Lake Victoria) are about 35 m above the present lake surface, and some 110 km inland of its western shore. The dates of the Nsongezi deposits are in doubt. Kendall (1969) cites authors who have given dates ranging from 60 000 years B.P. to 10 000 years B.P. Doornkamp and Temple (1966) suggest that continued tectonic warping has caused the eastward drift of the western shore of the lake. Climatic events have probably had an effect as well. Kendall (1969) states that from before 14 500 years B.P. to about 12 000 years B.P. Lake Victoria was a closed basin and the water had a high concentration of salts. From about 12 000 years B.P. to about 10 000 years B.P. the lake had an exit, which could have been to the south, but its locality is by no means certain. Around 10 000 B.P. to about 9500 B.P. the basin became closed again and then drained to the north cutting the Nile gorge. The water level in the lake rose after 12 500 B.P. There followed a period of aridity around 10 000 B.P., the water level fell and the outlet was lost. A wetter climate ensued, the lake level rose, overflowed to the north and established the Nile outflow. It is difficult to correlate these events because tectonic movements, climatic changes and the rate of discharge from the lake have all had an effect upon the lake size, level and position. The date of cessation of the tectonic movements is not known with certainty but there are three horizontal raised beaches 3, 12 and 18 m above the lake level which were presumably formed after earth movements had ceased. The most recent of these has been dated at 3720 years B.P. (Stuvier *et alii* 1960). Kendall (1969) argues that they all must be post 12 500 B.P. which may well indicate that tectonicity had stopped by that time. The different beach levels are possibly related to stages in the erosion of the Nile gorge.

Much less is known about Lake Kivu and very little absolute dating has been done. Lake Kivu resulted from the effects of eruptions of the Mufumbiro (or Bufumbiro) volcanoes (to the north of the present lake) when lava flows dammed the rift valley. Prior to this unknown date the drainage in this part of the rift is usually thought to have been northwards, but there may have been a proto-Lake Kivu. Cahen (1954) describes the origin of Lake Kivu as the result of the landscape changes which affected a network of rivers flowing S.W. to N.E. which curved northwards and ponded-up to form the lake. This direction of flow is possibly not compatible with the ideas of Cooke (1958) who describes the drainage as roughly E. to W. but this may have been due to local topographical features. The lake later rose in height and spilled over southwards to drain into Lake Tanganyika cutting the Ruzizi gorge. Kendall (1969) noted that *circa* 12 450 B.P. Lake Kivu was 100 m higher than its present level. This date was established by radio-carbon dating on mollusc shells on a raised beach. Possibly this immediately pre-dates the formation of the Ruzizi river.

The critical date of the eruption of the Mufumbiro volcanoes is unknown. Cahen (1954) states that it was before the end of the alleged Kamasien; Bishop (pers.

comm.) dates the eruptions as upper Pleistocene and Fryer (1968) suggests a date of about 100 000 years B.P. Lake Kivu has been connected to Lake Tanganyika for a minimum period of 12 000 years and although *Barbus altianalis* is found in the Ruzizi river at the Lake Kivu end it has not been recorded from Lake Tanganyika (Poll 1953; Marlier 1953). *Barilius moorii* has made the journey in the other direction (Poll 1950). Why only *Barilius moorii* has been able to ascend the Ruzizi river is a question that I am unable to answer. It may be that the ascent of the river is easier for some species than the descent is for others. There are also rapids on the Ruzizi river which must limit the amount of faunal interchange. All that one can say at the moment is that for at least the last 12 000 years only one species of fish is known to have successfully navigated the Ruzizi river.

A lake occupying the site on the floor of the western rift valley now occupied by Lakes Edward and George began to form at the time of the uplift of the rift wall. This corresponds with fig. 2B in Doornkamp and Temple (1966), and Bishop (1971) dates it as late Pliocene. Rivers drained onto the floor of the rift and a lake resulted. There was probably more than one lake, for the extensive Kaiso beds (later Pliocene) are lacustrine as, largely, are the overlying Semliki deposits (mid- to later Pleistocene). The full extent of the 'Kaiso' and 'Semliki' lakes both in time and area is not completely known. The Kaiso beds are up to 8000 feet thick (Brown 1956) and represent possibly three million years of comparative stability. Bishop (1969) noted that the Kaiso and Semliki deposits are separated in time by renewed movement of the rift valley boundary faults. The Semliki beds are found north of Lake Albert indicating a very large area for the 'Semliki' lake. The uppermost Semliki beds are later Pleistocene with an age in excess of 10 000 years B.P.

At the end of the Semliki period soil formation occurred and about 8000 years to 10 000 years B.P. the Katwe volcanoes ceased erupting and the present forms of Lakes Edward, George and the Kazinga channel became defined. The Kazinga channel runs through the Katwe lavas, but probably dates from the time that soil formation occurred, i.e. the post-Semliki period. The form of the channel was little altered by the volcanic activity (Bishop 1969: 45).

The Ishango beds, which were deposited during the active phase of the Katwe volcanoes (8000 years to 10 000 years B.P., Bishop, *op. cit.*), have yielded fossil *Barbus* species remains at Ishango on the Semliki river exit from Lake Edward (Greenwood 1959). From Site IX in Makalian strata, fossils comparable with *Barbus bynni* and *Barbus altianalis*, then dated Mesolithic or Holocene, were described by Greenwood (*op. cit.*). Site VI at Ishango, in the upper Semliki beds (Katanda formation), dated mid-Pleistocene [but older than the Nsongezi deposits (Bishop 1969)], yielded unidentifiable *Barbus* species fragments, the oldest known from this area.

Today the fish fauna of Lake Edward is different from that of Lake Albert, the former lacking species present in the latter. The Semliki river connects the two lakes; probably the rapids and possibly the cooler streams flowing down from the Ruwenzori mountains (Fryer 1968) prevent any faunal interchange. The fauna of Lake Edward is poor, lacking representatives of some widespread African fish families, e.g. Polypteridae, Characidae, Mochokidae, Centropomidae and Mastacembelidae, as well as some specifically Nilotic species present in Lake Albert, e.g.

Lates niloticus and *Barbus bynni*. This situation has been described in detail by Greenwood (1959).

Some of the species now absent from Lake Edward have been found fossilized in the Ishango beds. Kendall (1969) states that the major fish extinctions probably occurred within the last 18 000 years. *Polypterus*, *Lates*, *Synodontis* and *Barbus* cf. *bynni* were present some 8000–10 000 years ago. Characins disappeared much earlier in the fossil record, the latest known fossil *Hydrocynus* occurring in the Kaiso beds (probably lower Pleistocene). Certainly, at the time the Ishango beds were deposited, the fish fauna of Lake Edward was closer to that now in Lake Albert than it is today.

The Ishango beds lie on, and are also covered by, volcanic rocks (Bishop 1969). So, it would seem very possible that some species were killed by the outpourings of the Katwe eruptions. It is less likely that a drying up of the lake caused the extinctions because there is no evidence for such an event and Kendall (1969) suggests that in the Lake Victoria basin the period from 9500 B.P. to 6500 B.P. was marked by high water levels and the levels fell only slightly from 6500 B.P. onwards.

It is uncertain whether Lake Edward became completely denuded of fish life at the end of the Ishango period. If it did then the lake has been recolonized; if it did not, then some species must have escaped, or must have remained unaffected by the eruptions. Dr P. H. Greenwood (pers. comm.) reports having seen fish behaving normally within a hundred metres of a lava stream entering Lake Kivu, this suggests that perhaps an increase of toxic products in the water is more lethal than the heating effect of the lava. Possible means by which various species could have survived are discussed by Greenwood (1959). They include migration into feeder streams and different degrees of resistance to toxicity and low oxygen concentrations.

If there was an invasion from Lake Victoria it must have occurred since 8000 B.P. (the date of cessations of the Katwe volcanoes). However, since that time there is no evidence that Lake Victoria has been subjected to any great earth movements (see above) and it had already gained its outlet via the Nile gorge. This would limit any rises in water level to about 18 m above the present level. The watershed between Lakes Edward and George and Lake Victoria is extremely low. Now the Katonga river is blocked by Papyrus swamp but a few metres rise in water level might possibly enable fishes to travel from Lake Victoria into Lakes George and Edward. The fact that no, e.g. *Haplochromis*, fossils have been found in the Ishango beds does not necessarily mean that they have invaded the lake in post-Ishango times. The fossils could yet await discovery. Present studies (Dr P. H. Greenwood, pers. comm.) have suggested that Lake Edward *Haplochromis* species are not as closely related to particular Lake Victoria *Haplochromis* species as had been thought, which possibly militates against the idea of an invasion from Lake Victoria.

It seems much more likely that the fauna of Lakes Edward and George and Lake Kivu was originally widespread in the upper reaches of the old Congo system and became isolated in the present lake basins as a result of tectonicity. It would be very difficult to explain satisfactorily how *Barbus altianalis* could have migrated into Lake Kivu from either Lake Edward or Lake Victoria. At the time of the

highest known level reached by Lake Kivu, 12 450 B.P., Lake Victoria was not at its highest. However, it must be noted that Lake Victoria possibly had an outlet (see above) whose direction is unknown. The general topography of the Lake Kivu basin makes invasion from the east or north extremely unlikely.

If, as judged by their breeding habits (Whitehead 1964), *Barbus* species are fundamentally fluviatile fishes, then it is more likely that *Barbus altianalis* originally lived in the upper reaches of the Congo system in the area now occupied by Lakes Kivu, Edward, George and Victoria. Since the suggested modifications in its range the *Barbus altianalis* populations have undergone no significant morphological changes but the colour difference in the caudal fin is noted above.

DIAGNOSIS AND AFFINITIES. *Barbus altianalis* has three recognized subspecies which are meristically and morphometrically very similar. The pink caudal fin in Lakes Edward and George subspecies *Barbus altianalis eduardinanus* separates this subspecies from *Barbus altianalis radcliffii* of Lake Victoria. No information is available on the live colour of *Barbus altianalis altianalis* from Lake Kivu.

Barbus altianalis is, in gross morphology, similar to *Barbus intermedius* but the two species are separable on the modal lateral line count (see fig. 59), 26–34 (most frequently 28–32; mode 29) in *Barbus intermedius*; 28–35 (most frequently 30–34, mode 32) in *Barbus altianalis*. The last unbranched ray in the dorsal fin is slightly shorter in *Barbus altianalis* (9.0–30.4 per cent S.L., \bar{x} = 16.9) than in *Barbus intermedius* (6.9–33.9, \bar{x} = 20.1). The anterior and posterior barbels are shorter in *Barbus altianalis* (Ab 2.1–11.6 per cent S.L., \bar{x} = 4.3; Pb 2.3–12.4, \bar{x} = 5.4) than in *Barbus intermedius* (Ab 1.8–11.1, \bar{x} = 5.8; Pb 1.9–12.1, \bar{x} = 6.9).

For a comparison of *Barbus acuticeps* and *Barbus altianalis* see under the former species.

Barbus ruasae, from Rwanda, is somewhat similar in appearance to *Barbus altianalis* but can be distinguished easily from it by the fewer lateral line scales (25–26 against 28–35).

Barbus altianalis is considered here to belong to the *Barbus intermedius* group.

***Barbus bynni* (Forsskål) 1775**

Cyprinus bynni Forsskål, 1775, *Descrip. Anim.*: 71.

Barbus bynni: Blgr., 1911, *Cat. Afr. Fish* 2: 26, fig. 8 (includes a full bibliography up to this date).

Barbus ruspolii Vinciguerra, 1896, *Annali Mus. civ. Stor. natn. Giacomo Doria* (2) 17: 29.

Barbus meneliki Pellegrin, 1905, *Bull. Mus. Hist. nat. Paris* 16: 293

Barbus bynni rudolfianus Worthington, 1932, *J. Linn. Soc. (Zool.)* 38: 132.

NOTES ON THE SYNONYMY. The type specimen of *Barbus bynni* is no longer extant (Klausewitz & Nielsen 1965) and a neotype has been selected (see below). The holotype of *Barbus ruspolii* is in a very poor state and has not been seen by me, but other specimens referred by Vinciguerra to *Barbus ruspolii* have been examined. The holotype and unique specimen of *Barbus meneliki* in the Paris Museum has been studied.

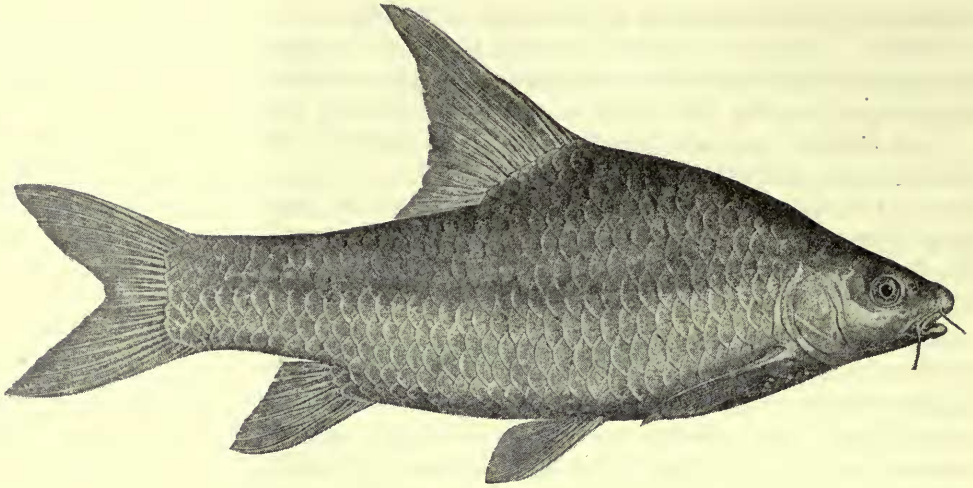


FIG. 17. *Barbus bynni* (from Boulenger 1911a).

The similarity of *Barbus bynni* to *Barbus ruspolii* was noted by Boulenger (1907) and by Worthington (1932a). The latter author was also of the opinion that *Barbus meneliki* from Lake Rudolf was close to his *Barbus bynni rudolfianus*. *Barbus meneliki* is very similar in many respects to *Barbus bynni rudolfianus* from the same lake. The greatest difference is the presence of 29/30 lateral line scales in the former against 34 or 35 in the latter. *Barbus bynni* from Lake Albert have a lateral line range of 28 to 35 scales. *Barbus meneliki* is based on the holotype and unique specimen so either it is an extremely rare fish in the lake or it is a member of Lake Rudolf's *Barbus bynni* population with fewer scales than usual. As I have seen only five *Barbus bynni* specimens from Lake Rudolf the latter suggestion seems the more likely especially when the information is compared with the lateral line scale count range in Lake Albert fish. The mouth of *Barbus meneliki* has a horny covering on the lower jaw, although this has not been seen in other Lake Rudolf specimens of *Barbus bynni*, it is not an unusual phenomenon in *Barbus* species (Groenewald 1958). In all other respects (e.g. dorsal spine length, caudal peduncle shape and scale striations) *Barbus meneliki* and *Barbus ruspolii* both closely resemble *Barbus bynni* hence I consider them conspecific. Boulenger (1907) remarked that little work had been done on the morphometric variation in *Barbus bynni*, both within one population and between isolated populations. What little I have been able to do is detailed below.

NEOTYPE. Klausewitz and Nielsen (1965) listed *Cyprinus bynni* as being 'no longer in existence from Forsskål's original collection'. I have also tried but without success to trace this specimen and must agree with Klausewitz and Nielsen that the specimen is, at least, lost. Therefore I have selected as a neotype B.M. (N.H.) specimen No. 1907.12.2 : 1230, a fish of 152 mm S.L. collected from

the Nile at Asswan. Forsskål did not state the size of his specimen nor its exact locality, so I have selected this fish as it appears to be a modal representative of the fishes from the lower Nile.

DESCRIPTION. The description is based on a total of 63 fish; 36 from the lower and White Niles; ten from Lake Albert; five from the Blue Nile; seven from Lake Abaya and five from Lake Rudolf. A further specimen doubtfully from the Webi Shebeli will be treated separately.

The body is shaped like an elongate rhomboid, the dorsal profile rises sharply and evenly from the snout to the occiput and then more steeply to the origin of the dorsal fin. The profile of the belly slopes down to a point in front of the ventral fins. The body is compressed, more so than in most other species under consideration. The compressed caudal peduncle is short and deep and is quite characteristic for *Barbus bynni*.

The scales bear sinuous longitudinal striae.

The most distinctive features are the massive dorsal spine and the caudal peduncle. At least one specimen (a fish from the lower Nile) shows the development of 'rubber lips'.

The following tables show the range, mean, standard deviation and standard error of the measurements taken for the five populations.

Range of standard lengths of the populations examined (in mm)

		No. of specimens
Nile	59-351	36
Lake Albert	136-349	10
Blue Nile	95-246	5
Lake Abaya	236-329	7
Lake Rudolf	196-233	5
Total	59-351	63

Body depth (this and all subsequent data are expressed as percentages of the S.L.)

Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	32.9	2.5	0.4	26.0-37.7
Lake Albert	10	34.6	2.7	0.8	31.0-39.6
Blue Nile	5	34.3	1.9	0.8	31.6-36.2
Lake Abaya	7	35.0	2.5	1.0	31.4-37.7
Lake Rudolf	5	33.6	2.3	1.0	30.0-36.0
Total	63	33.6	2.5	0.3	26.0-39.6

Head length

Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	24.0	1.7	0.3	21.4-30.6
Lake Albert	10	24.7	1.0	0.3	23.6-26.9
Blue Nile	5	25.3	0.7	0.3	24.4-26.3
Lake Abaya	7	24.9	1.3	0.5	23.1-26.2
Lake Rudolf	5	24.3	0.6	0.3	24.0-25.3
Total	63	24.4	1.5	0.8	21.4-30.6

Eye diameter					
Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	7.0	1.3	0.2	4.3-10.2
Lake Albert	10	6.7	1.1	0.4	5.7- 8.3
Blue Nile	5	7.2	0.7	0.3	6.9- 8.4
Lake Abaya	7	5.7	0.5	0.2	5.3- 6.3
Lake Rudolf	4	7.0	0.3	0.2	5.5- 7.3
Total	62	7.0	1.3	0.2	4.3-10.2

Interorbital width					
Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	8.1	0.8	0.1	7.0-11.7
Lake Albert	10	8.6	1.0	0.3	7.0-10.5
Blue Nile	5	8.2	0.8	0.4	7.2- 8.7
Lake Abaya	7	8.4	0.4	0.1	8.1- 8.8
Lake Rudolf	4	8.0	0.3	0.1	7.7- 8.3
Total	62	8.2	0.8	0.1	7.0-11.7

Mouth width					
Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	5.5	0.7	0.1	4.2-7.3
Lake Albert	10	6.0	0.6	0.2	4.9-6.9
Blue Nile	5	5.9	0.4	0.2	5.4-6.5
Lake Abaya	7	6.2	0.7	0.3	5.4-6.9
Lake Rudolf	4	5.0	0.7	0.3	4.3-5.8
Total	62	5.7	0.7	0.1	4.2-7.3

Pectoral fin length					
Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	21.3	1.3	0.2	18.4-24.3
Lake Albert	10	21.5	1.0	0.3	19.0-22.6
Blue Nile	5	24.5	1.3	0.6	23.1-25.8
Lake Abaya	7	24.2	1.9	0.7	21.6-26.4
Lake Rudolf	5	21.0	1.2	0.5	19.6-22.5
Total	63	21.9	1.8	0.2	18.4-26.4

Caudal peduncle length					
Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	17.0	1.5	0.2	13.5-21.1
Lake Albert	10	16.4	1.5	0.5	14.7-19.7
Blue Nile	5	16.2	0.7	0.3	15.4-17.0
Lake Abaya	7	17.1	1.8	0.7	15.5-20.6
Lake Rudolf	4	17.1	0.6	0.3	16.6-17.5
Total	62	16.9	1.4	0.2	13.5-21.1

Caudal peduncle depth

Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	13.8	1.6	0.3	11.7-19.4
Lake Albert	10	14.3	0.9	0.3	13.1-15.4
Blue Nile	5	13.5	0.5	0.2	12.6-18.0
Lake Abaya	7	13.6	0.7	0.3	12.6-14.6
Lake Rudolf	5	13.4	0.1	0.1	13.0-13.9
Total	63	13.8	1.3	0.2	11.7-19.4

Snout length

Locality	n	\bar{x}	s.d.	s.e.	range
Nile	36	7.7	0.7	0.1	6.7-10.5
Lake Albert	10	7.8	0.9	0.3	5.7- 9.2
Blue Nile	5	8.1	0.3	0.1	7.7- 8.4
Lake Abaya	7	8.2	0.4	0.1	7.6- 8.8
Lake Rudolf	5	8.0	0.3	0.1	7.5- 8.3
Total	63	7.8	0.7	0.1	5.7-10.5

Anterior barbel

Locality	n	\bar{x}	s.d.	s.e.	range
Nile	34	4.6	1.4	0.2	2.3-6.0
Lake Albert	10	2.4	0.8	0.1	1.2-4.6
Blue Nile	5	6.3	1.1	0.4	5.7-6.9
Lake Abaya	7	5.7	0.5	0.2	4.6-6.1
Lake Rudolf	5	2.5	0.5	0.2	2.1-2.9
Total	61	4.4	1.4	0.1	1.2-6.9

Posterior barbel

Locality	n	\bar{x}	s.d.	s.e.	range
Nile	34	5.8	1.0	0.1	4.2-8.4
Lake Albert	10	4.2	1.1	0.3	3.2-6.9
Blue Nile	5	6.5	0.5	0.2	6.1-7.4
Lake Abaya	7	6.1	0.5	0.1	5.7-6.8
Lake Rudolf	5	4.0	0.2	0.1	3.9-4.3
Total	61	5.5	1.2	0.1	3.2-8.4

Of particular note is the ratio of the caudal peduncle length to its depth, which has a mean value of 1.23. Only one specimen that I examined had a ratio greater than 1.40.

The figures presented here show that the barbels are shorter in fishes from Lakes Rudolf and Albert than they are in the other localities but the significance, considering the inequality of the samples, is low.

On the basis of the evidence from morphometrics any attempt to maintain or establish sub-specific categories is rather unsound. Any such attempts must be supported by evidence not available to the museum worker.

Squamation. The scales of *Barbus bynni* have slightly irregular parallel striae (fig. 93). There are from 28 to 37 scales in the lateral line series. The range and

the mean (to the nearest whole number) of scales on the lateral lines from the different localities are given below.

Locality	\bar{x}	range
Nile	33	31-37
Lake Albert	32	28-35
Blue Nile	31	28-33
Lake Abaya	32	31-34
Lake Rudolf	33	28-35
Total	33	28-37

Six and a half (less frequently 5.5) scales are present between the dorsal mid-line and the lateral line. Five and a half (rarely 6.5 or 4.5) scales are present between the lateral line and the ventral mid-line. The number of scales between the lateral line and the base of the ventral fin varies from 2 to 4.5; then, 2 (f.1), 2.5 (f.20), 3 (f.20), 3.5 (f.14), 4 (f.7), 4.5 (f.1). There is no apparent correlation between locality and this count. There are from 12 to 16 scales around the caudal peduncle; 12 (f.8), 13 (f.22), 14 (f.17), 15 (f.7), 16 (f.7). The fish from the Blue Nile had 12 scales around the caudal peduncle whilst those from Lake Rudolf had 16. Two of the Lake Albert fish also had 16. The samples are too small though to use such a variable character to establish a population taxonomically.

Dorsal fin. The dorsal fin has 8 (f.1), 9 (f.59), 10 (f.3) branched rays, the fourth unbranched ray is ossified into a straight, massive spine.

Dorsal spine.

	n	\bar{x}	s.d.	s.e.	range
White Nile	36	29.3	3.4	0.6	23.7-38.4
Lake Albert	10	30.9	2.5	0.8	24.9-35.2
Blue Nile	5	36.4	5.0	2.2	29.5-40.0
Lake Abaya	7	35.3	3.9	1.5	28.8-39.3
Lake Rudolf	5	34.1	5.2	2.3	30.0-43.0
Total	63	31.1	4.3	0.6	23.7-43.0

The *anal fin* has three unbranched rays and five branched rays.

Pharyngeal bones and teeth. The pharyngeal teeth (fig. 18) number five in the inner row. The first tooth is small and angled towards the second tooth. This tooth becomes mammilliform with increasing size but is almost always higher than it is long (cf. *Barbus gananensis*). Small concavities develop on the posterior face of the crown on teeth 3, 4 and 5. These three teeth become successively more slender and the fifth tooth becomes markedly hooked in large fishes. The three teeth of the second row and the two teeth of the third row resemble the last tooth in the inner row in shape. A series of pharyngeal bones (fig. 19) shows the variation in shape with the growth of the fish.

Gill rakers. There are 12 to 16 gill rakers on the lower limb of the first gill arch.

Coloration. Described by Boulenger (1911a) as yellowish or silvery, grey or olive on the back, fins yellow or orange, anal and caudal pink or red, ends of dorsal and

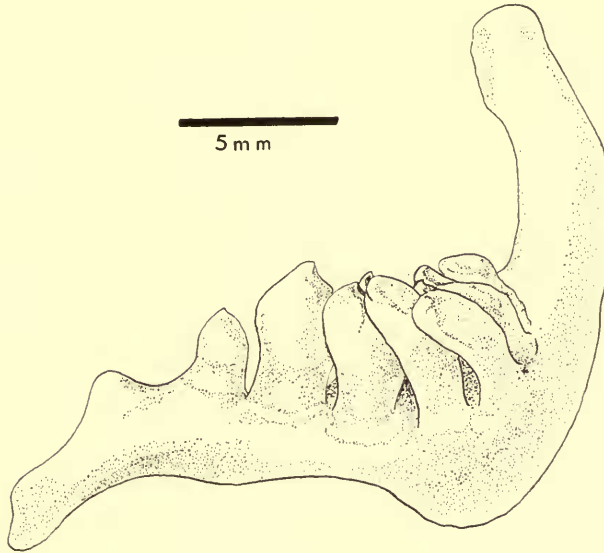


FIG. 18. Dorsal view of the left pharyngeal of *B. bynni* of 280 mm S.L.

caudal rays sometimes blackish. Amirthalingam (1965), describing *Barbus bynni* from the Sudan, states that the colour is very variable, but in live fish of about 250 mm is frequently as follows: body silvery, dark above and light below; all fins with deep-orange streaks; dorsal and caudal fins edged with black; anal, pelvic and pectoral fins edged with white.

DISTRIBUTION. Specimens from Lake Abaya, Lake Rudolf and Lake Albert have been examined. Sandon (1950) states that *Barbus bynni* is common in the Blue Nile and I have seen specimens from the Metti and Gudar rivers and from Rosaires. Sandon (*op. cit.*) also refers to the widespread distribution of *Barbus bynni* throughout the White Nile, although the B.M. (N.H.) collections have no specimens from between Khartoum and Lake Albert. This species is common throughout the lower Nile.

Specimens nos. 92-101 listed by Boulenger (1911a: 28) from Lake Baringo are not referable to this species, but belong to *Barbus intermedius*.

Peel (1900: 336) records *Barbus bynni* (sic) from the Webi Shebeli in Somaliland. Donaldson-Smith (1897) collected three specimens of a *Barbus* species identified as *Barbus bynni* by Günther (1896); the two small specimens from Stony Brook, the Errer river (Webi Shebeli system) (Academy of Natural Sciences Philadelphia, Nos. 14541, 14542), are not *Barbus bynni* but the large specimen is. The two small fishes are mentioned with details of the locality in Donaldson-Smith's account of his expedition but there is no mention of the large fish. Günther (1896) gives its locality as the Shebeli river. This specimen is now in the collection of the Philadelphia Academy of Natural Sciences No. 16710, where the locality Thebeti, East Africa, has been given to it. Thebeti could well be a mis-reading of Shebeli, for the

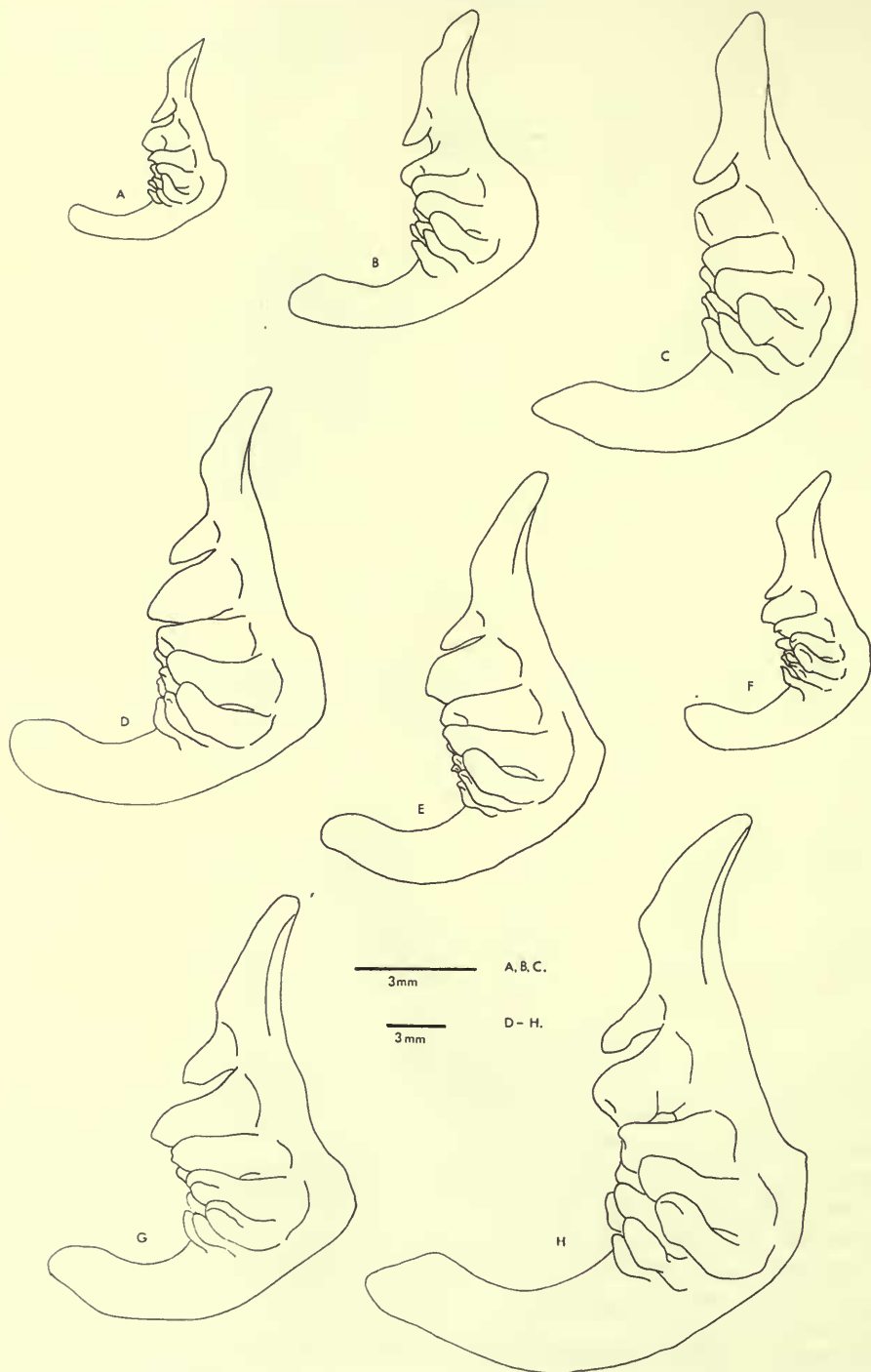


FIG. 19. A series of pharyngeal bones from specimens of *B. bynni* to show the variation with the size of the fish. Standard lengths (mm) of the specimens are A = 58; B = 98; C = 140; D = 260; E = 235; F = 171; G = 280; H = 350.

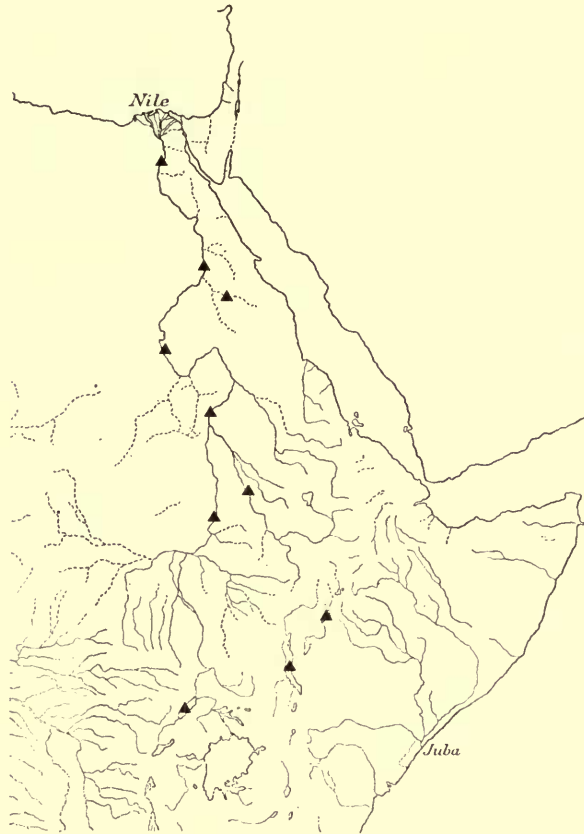


FIG. 20. Map of the distribution of *B. bynni*.

writing on the label inside the gill cover is very faint. This fish is certainly *Barbus bynni* but its locality is in some doubt and it is not included with the data presented above. Its measurements, however, will appear at the end of this section.

Vinciguerra (1898) gives Bissan Guarrica as a locality for *Barbus ruspolii*. As far as I can find out this is a tributary of the Sagan river which drains into Lake Stephanie.

Lakes Rudolf and Abaya are now isolated from the Nile system. Fryer (1968) suggests that the Southern Ethiopian rift valley lakes drained into Lake Rudolf and Lake Rudolf was connected to the Nile via the Sobat river (or via the present Lotagipi and Kenamuki swamps as suggested by Cooke 1958). Therefore *Barbus bynni* could have been isolated in the distal parts of what was once a more extensive Nile system. *Argulus rhipidiophorus*, a parasitic crustacean discussed by Fryer (*op. cit.*) is also found in the Nile, Lake Rudolf and the Ethiopian rift valley lakes. Greenwood (1959) has recorded remains of fishes closely resembling *Barbus bynni* from an epi-Pleistocene site at Ishango near the source of the Semliki river on Lake Edward. *Barbus bynni* is now extinct in Lake Edward (see p. 26).

Barbus bynni is confined to the Nile system and is also found in lakes that were once connected to the Nile.

DIAGNOSIS AND AFFINITIES. *Barbus bynni* has some gross morphological characters in common with *Barbus gananensis*, *Barbus oxyrhynchus* and *Barbus longifilis*. The characters in common include a rhomboidal compressed body, a strong, straight, smooth dorsal spine and parallel, sinuous striae on the scales. The species listed above are considered to be closely related and comprise the *Barbus bynni* complex which is discussed further on page 128.

Barbus bynni can be distinguished from *Barbus gananensis* by the length and strength of the dorsal spine (longer and stronger in the former species) and by the shape of, particularly, the second tooth in the inner pharyngeal row. In *Barbus gananensis* this tooth is higher and longer than in *Barbus bynni* (see fig. 28). The anterior edentulous process of the pharyngeal bone is relatively longer in *Barbus bynni* than in *Barbus gananensis*.

The other two species are well separated geographically from *Barbus bynni*. *Barbus longifilis* can easily be distinguished by its barbels (Ab, \bar{x} = 8.9, range 8.3-9.6; Pb, \bar{x} = 11.3, range 9.5-13.4) which are much longer than those of *Barbus bynni* (Ab, \bar{x} = 4.4, range 1.2-6.9; Pb, \bar{x} = 5.5, range 3.2-8.4).

Barbus oxyrhynchus has fewer scales in the lateral line series than has *Barbus bynni* (21-29, most frequently 22-25 against 28-37, most frequently 31-33). The dorsal spine is usually thinner and shorter in *Barbus oxyrhynchus* than in *Barbus bynni* (\bar{x} = 25.3 in *Barbus oxyrhynchus*, \bar{x} = 31.1 in *Barbus bynni*).

Barbus bynni P.A.S. No. 16710 (see above)

L = 349 mm; D = 31.0; H = 21.8; I = 5.4; IO = 8.6; MW = 5.1; Pct = 23.2; CPI = 14.6; CPd = 13.4; Snt = 6.9; Ab = 4.0; Pb = 4.9; DSp = 29.3.

Dorsal fin IV-9. Twelve scales around caudal peduncle; 31 in lateral line, 5.5 between dorsal mid-line and lateral line, 5.5 from lateral line to ventral mid-line; 2.5 between lateral line and base of pelvic fin.

Barbus caudovittatus Boulenger 1902

Barbus caudovittatus Blgr., 1902, *Annl. Mus. r. Congo Belge Zool.* (1) 2 : 32; Poll, 1953, *Résult. scient. Explor. hydrobiol. Lac Tanganika* 3 (5A) : 85.

Varicorhinus stappersii Blgr., 1917, *Ann. Mag. nat. Hist.* (8) 20 : 364.

Barbus euchilus Blgr., 1919, *Proc. zool. Soc. Lond.* : 400.

Barbus miochilus Blgr., 1919, *Proc. zool. Soc. Lond.* : 401.

Barbus lestradei David, 1936, *Revue Zool. Bot. afr.* 27 (2) : 150, fig. 1.

Barbus chilotes sakaniae Poll, 1938, *Revue Zool. Bot. afr.* 30 (3) : 413, fig. 13.

Barbus pojeri Poll, 1944, *Bull. Mus. r. Hist. nat. Belg.* 20 (3) : 2, fig. 3.

NOTES ON THE SYNONYMY. Poll (1946) synonymized *Barbus euchilus* and *Barbus miochilus* and then in 1953 included *Barbus pojeri* within the expanded *Barbus euchilus*. After examination of the type specimens I agree with Poll, although it is worth noting that the dorsal fin spines of *Barbus euchilus* and *Barbus miochilus* are more strongly ossified than is the norm in *Barbus caudovittatus*.

Barbus lestradei had been recognized as a separate species by authors since its first description by David (1936). The type specimen in the Central African Museum at Tervuren has IV-9 rays in the dorsal fin (not II-9) and 27 scales in the lateral line. It is a large fish (S.L. 373 mm) as are almost all fish referred to *Barbus lestradei*. The body is dark coloured, but the measurements, the weakly ossified dorsal spine, overall body shape and the indications of darkening in body colour in some *Barbus caudovittatus* leave little room for doubt that *Barbus lestradei* is a synonym of *Barbus caudovittatus*. *Varicorhinus stappersii* was described from two specimens of 255 mm and 191 mm S.L. respectively from Nganza on the Lufuko river, Lake Tanganyika basin B.M. (N.H.) Reg. No. 1920.5.25 : 36-37, and two specimens from the same locality, M.A.C.T. No. 14222 of S.L. 175 and 184 mm. The morphometric data for the two B.M. (N.H.) specimens (not included below) are D = 29.0, 29.3; H = 20.8, 22.5; I = 4.7, 5.8; IO = 8.8, 8.6; MW = 9.4, 8.6; Pct = 21.2, 20.9; CPl = 19.2, 19.4; CPd = 11.8, 11.5; Snt = 7.5, 8.1; Ab = 3.9, 4.7; Pb = 5.5, 6.5; DSp = 9.4, 10.0; D. fin IV-10, IV-9. The morphometric data of these two fish are given separately to facilitate a comparison with the morphometric data of the other specimens of *Barbus caudovittatus*. There are 12 scales around the caudal peduncle, 28 in the lateral line, 4.5, 5.5 in the transverse series and 2.5 between the lateral line and base of the pelvic fin. The M.A.C.T. specimens agree closely with these measurements.

The mouth is broad with a straight, horny edge to the lower jaw. The width of the mouth is a natural consequence of achieving the '*Varicorhinus*' facies, as perhaps is the decrease in head length. The barbels are conspicuous and the pharyngeal bones are identical with those of *Barbus caudovittatus*. These features and the similarity between the morphometric data of *Varicorhinus stappersii* and *Barbus caudovittatus* suggest that the two specimens of *Varicorhinus stappersii* are highly modified 'sector' forms of *Barbus caudovittatus* (Groenewald 1958). The situation here parallels the case of *Varicorhinus brucii* and *Barbus brucii*, two species, displaying different facies, that were eventually synonymized by Jubb (1968). It is not within the scope of this paper to discuss the validity of the genus *Varicorhinus*, but there is sufficient awareness of the variability of *Barbus* species mouth parts to suggest that it is not unlikely that some African *Varicorhinus* species are highly modified individuals of various polymorphic *Barbus* species. The specimens from Koki, recorded by Poll (1953), are only doubtfully *Barbus caudovittatus*. The three fishes examined, B.M. (N.H.) 1955.12.20 : 870-872, ex Poll, are small, 43-47 mm S.L. with 10 or 11 branched rays in the dorsal fin, a well-ossified dorsal spine, 24-25 scales in the lateral line and no dark marks on the caudal fin. Although these Koki specimens come from within the distributional limits of *Barbus caudovittatus* I have too little information to decide whether they are a separate species or a distinct population of *Barbus caudovittatus*. They have not been considered to be *Barbus caudovittatus* in this account.

HOLOTYPE. A fish of 77 mm S.L., M.A.C.T. No. 1168, from Banzyville. Another specimen listed as 'one of the types' is in the collections of the British Museum (Natural History) No. B.M. (N.H.) 1901.12.26 : 26.

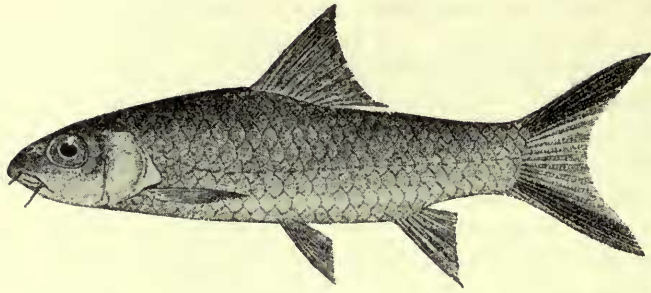


FIG. 21. *Barbus caudovittatus* (Holotype, from Boulenger 1911a).

DESCRIPTION. The description is based on 47 specimens. The morphometric data are expressed in tabular form as follows :

	\bar{x}	s.d.	s.e.	range
L				35 - 580 mm
D	28.8	3.4	0.5	24.1 - 37.5
H	26.6	2.0	0.3	21.4 - 31.4
I	7.5	1.6	0.2	4.7 - 11.4
IO	9.4	1.6	0.2	6.5 - 12.4
MW	7.3	0.8	0.1	5.7 - 8.9
Pct	21.0	1.5	0.2	18.1 - 24.7
CPl	16.8	1.5	0.2	12.8 - 19.7
CPd	12.2	1.4	0.2	8.6 - 15.8
Snt	8.9	1.1	0.2	6.5 - 11.4
Ab	4.4	1.1	0.2	2.3 - 7.5
Pb	5.8	1.6	0.2	3.1 - 11.3

Small specimens have a shallow compressed body, but this becomes deeper and thicker in larger fish. The mouth is small, inferior and frequently horse-shoe shaped. Thicker lips have been observed in some larger specimens from Lake Tanganyika, whilst in a specimen from the Luilu river (Sankuru system - Kasai ; M.A.C.T. No. 78925), the 'rubber-lipped' condition is approached.

The ventral profile of the body, from the jaw articulation to the anus, is straight or slightly convex. The illustrated specimen (the holotype) is not typical in this respect. The contrast between the ventral and dorsal profiles is usually greater in larger fishes.

Dorsal fin. The dorsal fin has four unbranched rays. In one fish from the Luberizi river (Ruzizi area) there are only three unbranched rays. David (1936) recorded only two unbranched rays in the type specimen of *Barbus lestradei*, but on examination of the type I found that there are four. The last unbranched ray is scarcely ossified and in the majority of specimens articulations persist almost to its base. A specimen from Nyundeulu (an affluent of the Lualaba), M.A.C.T. No.

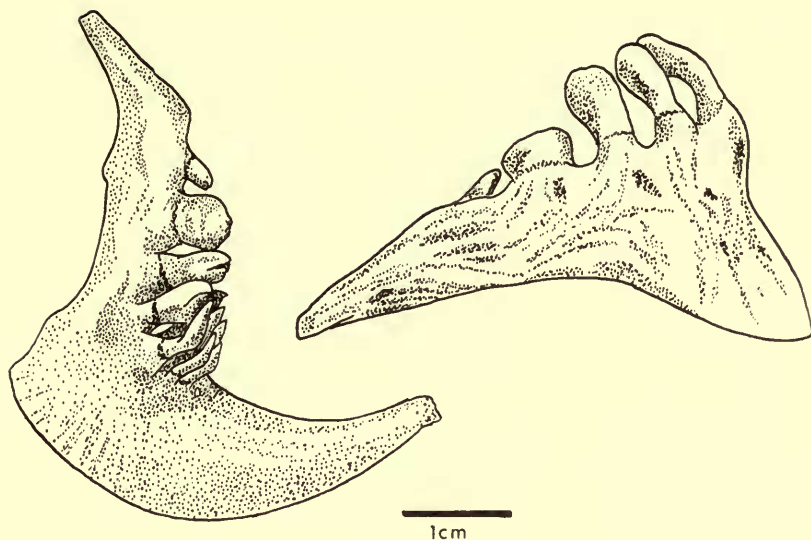


FIG. 22. Dorsal and lateral views of the right pharyngeal bone from a large specimen of *B. caudovittatus* of 420 mm S.L.

124937, has an ossified fourth dorsal ray with a length of 17 per cent of the standard length.

The branched rays range from 8 to 11 in number; 8 (f.3), 9 (f.40), 10 (f.3), 11 (f.1). The fishes with 10 and 11 branched rays in the dorsal fin all come from the river at Elizabethville (= Lubumbashi). The last branched ray is commonly longer than the few rays immediately preceding it.

The anterior edge of the dorsal fin is in advance of the insertion of the pelvic fin. Because of the softness of the last unbranched ray it was impractical to measure its length using the same standards as for the other species.

The *anal fin* has three unbranched and five branched rays.

Squamation. The lateral line has 24–30 scales, 24 (f.3), 25 (f.6), 26 (f.12), 27 (f.13), 28 (f.8), 29 (f.4), 30 (f.1). There is no evidence for any geographical variation in these figures. There are 12 scales round the caudal peduncle and 4.5 (r. 5.5) scale rows between the dorsal mid-line and the lateral line and 4.5 (r. 5.5) between the lateral line and the ventral mid-line. Two and a half (r. 3) scale rows are present between the lateral line and the base of the pelvic fin.

Pharyngeal bones and teeth. The pharyngeal bones of a large specimen are shown in fig. 22 and of a small specimen in fig. 23.

The crowns of the teeth are hooked in small fishes but become molariform in large fish. No exception to the pharyngeal formula 2.3.5.–5.3.2 was found.

Gill rakers. The number of gill rakers on the lower limb of the first gill arch is between 11 and 15 in the specimens examined.

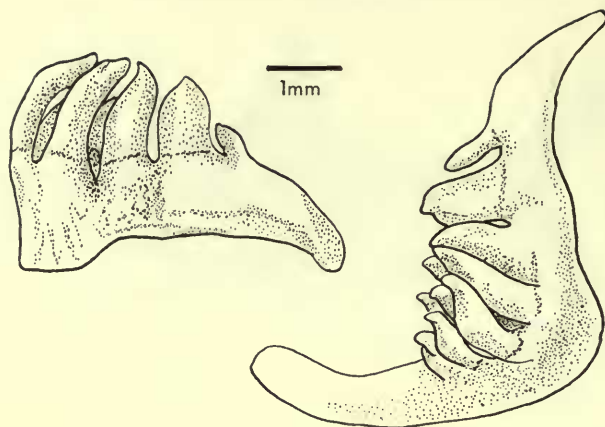


FIG. 23. Left pharyngeal bone from a specimen of *B. caudovittatus* of 110 mm S.L.

Coloration. In small specimens (less than about 50 mm S.L.) a small black spot is present on the caudal peduncle at the base of the caudal fin. This spot is not present on larger specimens but instead the dorsal and ventral edges of the caudal fin become darker. In fishes of from about 70 to 170 mm S.L. the dark bands on the caudal fin are conspicuous. Above this size the bands are less obvious as a result of the general darkening of the caudal fin.

In most specimens dark pigment is present on the distal parts of the anal, pelvic and pectoral fins. This is most noticeable in medium-sized fishes.

The body is brown in alcohol-preserved specimens. Large fishes are darker than small fishes.

DISTRIBUTION. Specimens have been examined from Elizabethville (= Lubumbashi) (Lualaba Congo); Banzyville (= Mobayi) (Ubangi Congo); Avakubi (Ituri); Tshikapa, Luembe, and Tchitatu rivers (upper Kasai); Bushiame and Lulu rivers (Sankuru system); Dundo, Angola; Stanleyville (= Kisangani) (Wamba river); Yangambe (Isalowe river - Uele system); Luberizi river (Ruzizi river) and from Lake Tanganyika.

Poll (1953) thinks that the presence of *Barbus caudovittatus* (as defined here) in Lake Tanganyika is fortuitous and that it essentially is a fluviatile species.

DIAGNOSIS. *Barbus caudovittatus* is a slender-bodied fish characterized by a very soft, poorly ossified last simple ray in the dorsal fin and a dark band on each lobe of the caudal fin. It is most likely to be confused with *Barbus trachypterus* and *Barbus paucisquamatus* which it superficially resembles in body shape, scale counts, and mouth position and mouth shape. It is not yet possible to determine whether these three species are related as I have seen too few specimens of the latter two species. The dorsal spines of *Barbus trachypterus* (\bar{x} = 18.6, range 16.1-21.3) and *Barbus paucisquamatus* (\bar{x} = 19.7, range 14.1-22.5) are much longer and better ossified than is normal in *Barbus caudovittatus*, but a few specimens have developed

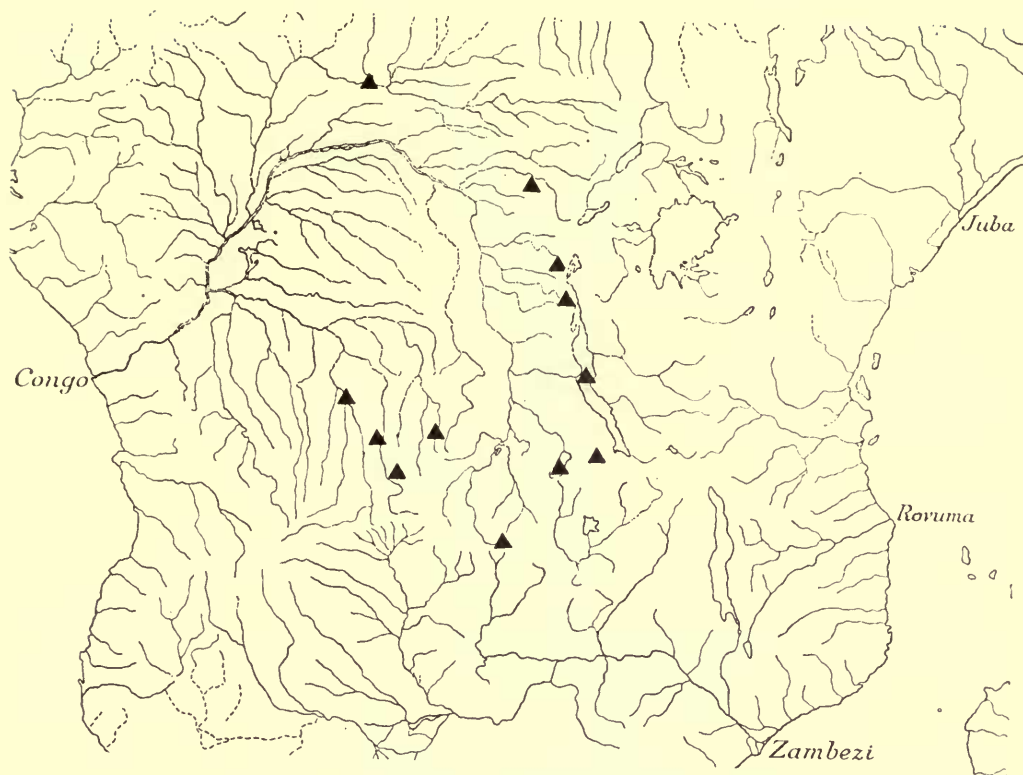


FIG. 24. Map of the distribution of *B. caudovittatus*.

spines of up to 17 per cent S.L. Dark pigment is present on the distal parts of the pectoral, pelvic and anal fins in *Barbus caudovittatus* and *Barbus paucisquamatus* but on the proximal parts of these fins in *Barbus trachypterus*. The barbels are much shorter in *Barbus caudovittatus* (Ab, \bar{x} = 4.4, range 2.3-7.5; Pb, \bar{x} = 5.8, range 3.1-11.3) than in *Barbus paucisquamatus* (Ab, \bar{x} = 7.5, range 5.8-10.6; Pb, \bar{x} = 8.6, range 6.2-11.6).

Barbus ethiopicus Zolezzi 1939

Barbus ethiopicus Zolezzi, 1939, *Boll. Pesca Piscicult. Idrobiol. Roma* 15 : 369, fig. 1.

HOLOTYPE. A fish of *circa* 230 mm S.L. from Lake Zwai. This specimen has not been seen by me but is the only one described by Zolezzi. The specimen is housed in the Laboratorio centrale di Idrobiologia in Rome.

DESCRIPTION. The description is based on three specimens of 240, 250 and 258 mm collected in Lake Zwai by Mr Eric Hamblyn. B.M. (N.H.) Nos. 1971.7.12 : 1-3.

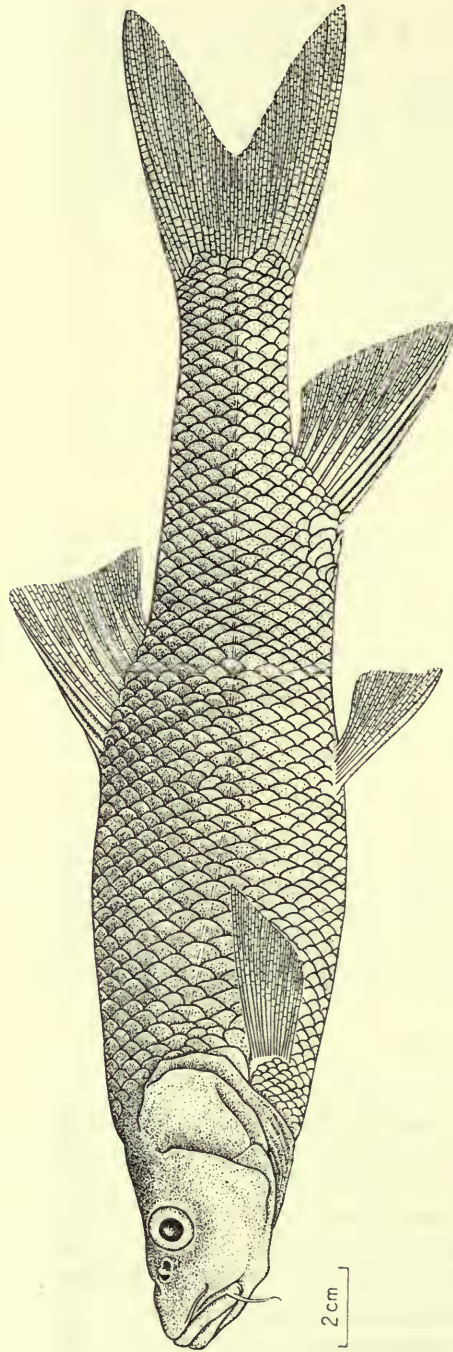


FIG. 25. *Barbus ethiopicus*.

The range of ratios (expressed as percentage of S.L.) for the three specimens is as follows.

D	23.2-24.6	CPI	15.8-17.0
H	25.8-27.1	CPd	8.4-10.0
I	5.8- 6.2	Snt	8.8- 9.4
IO	8.0- 8.8	Ab	3.6- 4.2
MW	7.0- 7.9	Pb	3.6- 4.7
Pct	16.3-18.7		

Calculation of the standard deviation and the standard error with only three specimens was not considered a profitable action.

The elongate body is round in cross-section and the caudal peduncle is long in relation to its depth. The mouth is wide and the gape is terminal. The body was covered with a thick layer of mucus which had to be removed before scale counts could be taken. There are 39 (= 18 + 21) vertebrae.

Dorsal fin. The dorsal fin has four unbranched rays. The last unbranched ray is weakly ossified as a smooth spine from 8.4 to 9.6 per cent of the standard length. The three specimens have 6 (f.1), 7 (f.1) or 8 (f.1) branched dorsal fin rays. The holotype has eight. This degree of variation is unusual and the number of branched rays is low for the large *Barbus* species of East Africa although not infrequent in the small *Barbus* species with radiately striated scales. The dorsal fin is inserted slightly in front of the pelvic fins.

The *anal fin* has three unbranched and five branched rays.

Squamation. The lateral line has 46 (f.1), 48 (f.1) or 52 scales (48 and 50 on either side of the holotype), a number much higher than in any other large *Barbus* species of the region. There are 18 scales round the caudal peduncle (18-20 in the holotype according to Zolezzi). Between the dorsal mid-line and the lateral line there are 9.5 (f.1) or 10.5 (f.2) scale rows and 10.5 (f.2) or 11.5 (f.1) between the lateral line and the ventral mid-line. Five and a half scale rows are present between the lateral line and the base of the pelvic fin.

Pharyngeal bones and teeth. The pharyngeal teeth number 2.3.5.-5.3.2 (fig. 26), the first two teeth in the inner row are conical with small depressions on the posterior face of the crown. In succeeding teeth the concavity becomes larger and as the stem of the tooth becomes thinner the whole tooth assumes a spatulate appearance with a recurved tip.

There are 10 (f.1) or 11 (f.2) *gill rakers* on the lower limb of the first gill arch in the three specimens examined.

Coloration. The preserved fishes are olive grey-brown on the back and flanks to just below the lateral line. The ventral part of the flanks and the belly are orangeish to pinkish-brown. The dorsal fin and the dorsal lobe of the caudal fin are olive-brown. The other fins are pale brown.

DISTRIBUTION. Known only from Lake Zwai, Ethiopia.

DIAGNOSIS AND AFFINITIES. *Barbus ethiopicus* is easily distinguished from the other species described in this paper. It has a shallow, almost cylindrical body

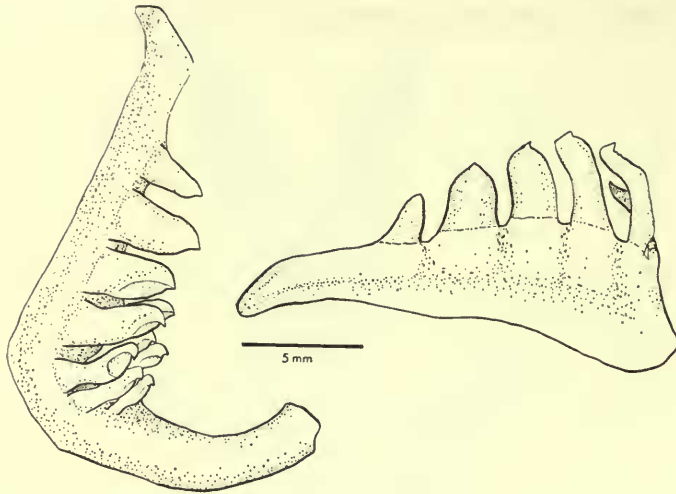


FIG. 26. Left pharyngeal bone of *Barbus ethiopicus*. Dorsal and lateral views.

with more than 46 scales in the lateral line. *Barbus microterolepis*, known by one specimen from a stream flowing into Lake Zwai, has only 40 scales and a much more compressed body.

Small-scaled *Barbus* species from the region under discussion in this paper are confined to lake basins, e.g. *Barbus tropidolepis* and *Barbus platyrhinus* of Lake Tanganyika. However, it is not possible to decide, in these cases, whether the small scales are an adaptation to a primarily lacustrine environment or not. The geological history of the Lake Zwai basin is not known in enough detail to determine how long the lake was isolated from the major rivers of the area and hence whether *Barbus ethiopicus* represents a relict population from a once widespread small-scaled species (and here it must be noted that there are fluviatile small-scaled species in South Africa) or whether it is a modification of, for example, the *Barbus intermedius* stock with which it is now sympatric. *Barbus intermedius* as well as *Barbus microterolepis* is found in Lake Zwai. The possible relationships of the latter species to *Barbus ethiopicus* are discussed on p. 91.

The evidence for the affinities of *Barbus ethiopicus* is inconclusive. There are no characters which preclude its descent from a *Barbus intermedius* stock but equally there are no characters which positively suggest a relationship with such a stock.

In the absence of positive information, the affinities of *Barbus ethiopicus* are left in abeyance and it is not, in this paper, considered to be related to *Barbus intermedius*.

Barbus gananensis Vinciguerra 1895

Barbus gananensis Vinciguerra, 1895, *Annali Mus. civ. Stor. nat. Giacomo Doria* (2) 15: 53, pl. 5, fig. 2; Vinciguerra, 1897, *Annali Mus. civ. Stor. nat. Giacomo Doria* (2) 17: 362.

HOLOTYPE. The holotype M.S.N.G. (Museo Storia Naturale Genova) No. 17525 from the River Ganana (= Juba) between Lugh and Bardera in Somaliland was

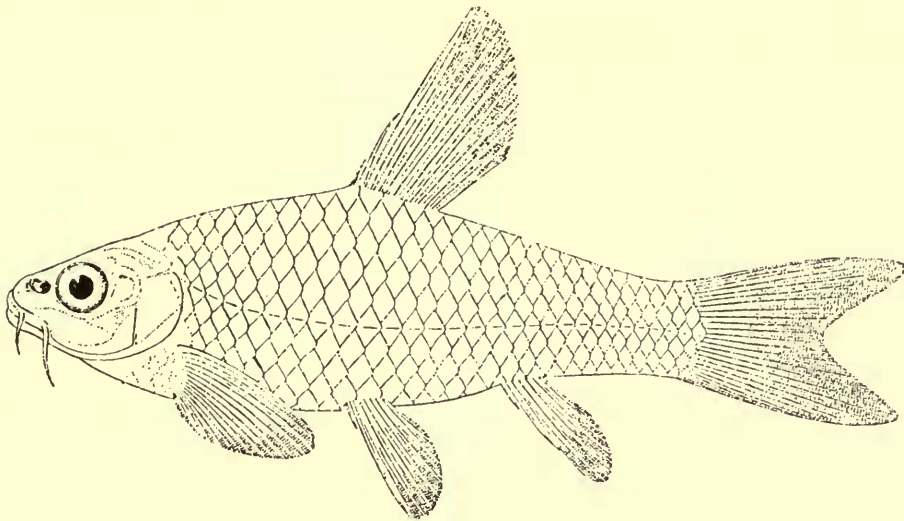


FIG. 27. *Barbus gananensis* (the holotype after Vinciguerra - in Boulenger 1911a).

figured by Vinciguerra. It is now in extremely poor condition and I have not been able to examine it although it was examined for me by Dr E. Tortonese. I have though, through the kindness of Dr E. Tortonese, been able to examine two paralectotypes. These are small fish of 50 and 39 mm S.L. and they came from the Auata river (= Awata). A further specimen from the type locality, a fish of 176 mm S.L., M.S.N.G. No. 17339, was studied and this specimen is illustrated (fig. 28) to compare with the original rather poor figure. A fourth fish, identified as *Barbus gananensis* from the Citerni collection from the Upper Ganana, M.S.N.G. No. 17343, is not referable to this species.

The description is therefore based upon three specimens.

DESCRIPTION. As a result of the description being based on two small fish and one larger specimen, certain morphometric data show a large range. Only the range is shown as other calculations could be misleading.

L	39 - 176 mm	Pct	23.1-24.0
D	28.2-32.0	CPl	16.5-18.0
H	25.0-28.2	CPd	13.1-15.0
I	7.4-10.2	Snt	7.7- 8.0
IO	6.0- 8.5	Ab	2.6- 6.3
MW	4.5- 7.7	Pb	6.0- 7.9

The calculations are expressed as percentages of the standard length.

The body is compressed and similar in outline to the body of *Barbus bynni*, although rather less deep. The caudal peduncle is not so square as in *Barbus bynni*, the ratio of the CPl/CPd is from 1.2 to 1.3 in *Barbus gananensis* against 1.0 to 1.2 in *Barbus bynni* of the same size.

Squamation. The scales bear parallel striae, slightly less sinuous than is typical for *Barbus bynni*. There are 29 (f.2) or 31 (f.1) scales in the lateral line and 12 scales

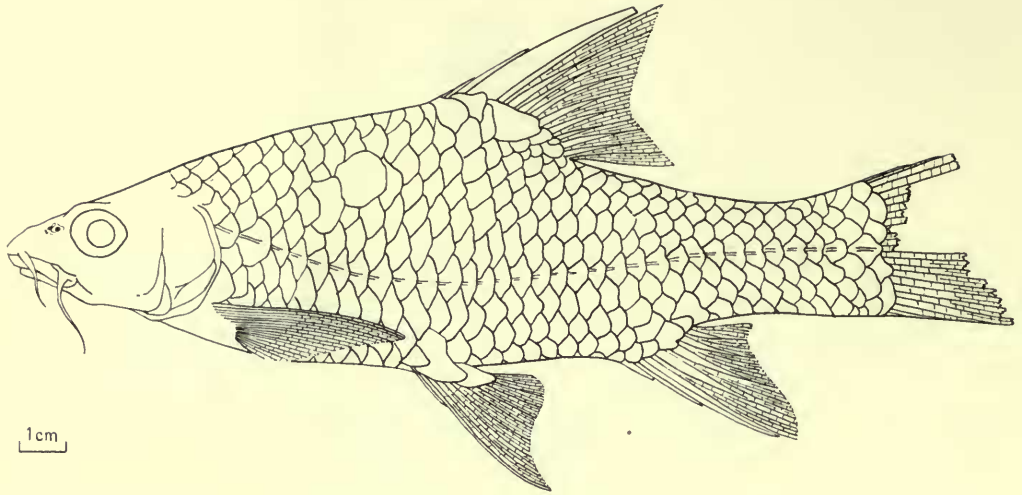


FIG. 28. *Barbus gananensis*, a specimen of 176 mm S.L.

around the caudal peduncle. The other scale counts were only possible for the largest specimen and here there are 5.5 scales between the dorsal mid-line and the lateral line, 5.5 scales between the lateral line and the ventral mid-line and 2.5 scales between the lateral line and the insertion of the pelvic fin.

Dorsal fin. The dorsal fin has four unbranched rays and nine branched rays. The base of the fin is enveloped by a sheath of scales. The last unbranched ray forms a smooth ossified spine from 18.0 to 22.7 per cent of the standard length. This is rather less than in similar-sized specimens of *Barbus bynni*. The spine in the small specimens is conspicuously less well ossified than equal-sized *Barbus bynni* specimens. The origin of the dorsal fin is slightly in advance of the origin of the pelvic fin.

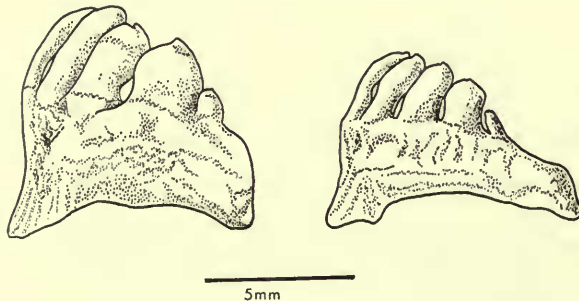


FIG. 29. A comparison of the left pharyngeal bones from a specimen of *B. gananensis* of 176 mm S.L. (left bone) with the left pharyngeal bone from a *Barbus bynni* of 171 mm S.L.

The *anal fin* has three unbranched rays and five branched rays. The last branched ray is markedly bifurcated.

Pharyngeal bones and teeth. The contrast between the pharyngeal bones of the 176 mm S.L. *Barbus gananensis* and a 171 mm S.L. *Barbus bynni* can be seen in fig. 29. The bone is thicker and deeper in the former and the teeth of the inner row are higher. The second tooth of the inner row in particular is much longer in *Barbus gananensis* than in *Barbus bynni*. These differences are equally clear in the pharyngeal bones of the smaller *Barbus gananensis* when compared with equal-sized *Barbus bynni*. The teeth of the second and third rows are only marginally more robust than in comparable *Barbus bynni* material.

Gill rakers. There are 12 gill rakers on the lower limb of the first gill arch in the largest specimen; the gill rakers could not be counted in the smaller specimens.

Coloration. In alcohol, the young fish are silvery flanked, with a brown back. The largest fish is sandy brown on the flanks and belly, darker on the back.

DISTRIBUTION. Collected from the Juba river (between Lugh and Bardera) and from the Awata river (upper Juba). Also it is reported from the confluence of the Ganana Dulei and Bas Nabor. It has not been recorded from the Webi Shebeli where *Barbus bynni* is found.

AFFINITIES. A species that is very close to *Barbus bynni*, differing in certain features mentioned above. A larger collection of *Barbus gananensis* may show modal differences further distinguishing it from *Barbus bynni*. The general impression culled from these three fish is that they resemble a *Barbus bynni* stock which has begun to approach the facies of the *Barbus oxyrhynchus* from the Athi and Tana systems immediately to the south, particularly in possessing slightly longer pectoral fins than is typical for *Barbus bynni* at these sizes, a reduced dorsal fin spine and no less than nine branched rays in the dorsal fin. However, this is based solely on an extremely small sample of fish and this trend (if it exists) must remain hypothetical until more information is available about *Barbus gananensis*.

Barbus intermedius Rüppell 1837

Barbus surkis Rüppell, 1837, *Mus. senckenb.* 2 : 5, pl. 1, fig. 1†; Blgr., 1902, *Ann. Mag. nat. Hist.* (7) 10 : 424; Blgr., 1907, *Fish Nile* : 226, pl. 42; Blgr., 1911, *Cat. Afr. Fish* 2 : 65.
Barbus intermedius Rüpp., 1837, *Mus. senckenb.* 2 : 7, pl. 1, fig. 2; Günther, 1864, *Proc. zool. Soc. Lond.* : 91 (non *B. intermedius* Rüpp. – *vide* Blgr., 1911 : 45); Blgr., 1902, *Ann. Mag. nat. Hist.* (7) 10 : 424; Blgr., 1907, *Fish Nile* : 228, pl. 29, fig. 2; Blgr., 1911, *Cat. Afr. Fish* 2 : 59, fig. 39.

† In *Tracts on Natural History*, vol. 4, in the Zoological Department library of the British Museum (Natural History) (Cat. No. 5 q T r) there is a separate of this Rüppell paper bearing the date 1835. The title page, pagination and figures are identical with those in the 1837 *Mus. senckenb.* except that the title page bears the inscription 'Ausgezogen aus dem II Band des Museum Senckenbergianum. Frankfurt am Main, 1835'.

As the cover of the second volume of the *Mus. senckenb.* bears the date 1836 and the title page the date 1837, I am assuming that the 1835 date is either a typographical error or an over-optimistic estimate of the date of publication. Until firm evidence to the contrary is available I shall continue to refer to Rüppell 1837.

- Barbus intermedius leptosoma* : Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 167, pl. 6, fig. 1 (vide *B. leptosoma* Blgr., 1902).
- Barbus intermedius microstoma* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 168, pl. 6, fig. 2.
- Barbus intermedius gorgorensis* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 168, pl. 6, fig. 3.
- Barbus affinis* Rüpp., 1837, *Mus. senckenb.* **2** : 8, pl. 1, fig. 3 ; Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 425 ; Blgr., 1907, *Fish Nile* : 216, pl. 29, fig. 1 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 47, fig. 28.
- Barbus affinis brevibarbis* : Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 162, pl. 1, fig. 2 (vide *B. brevibarbis* Blgr., 1902).
- Barbus affinis nedgia* : Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 163, pl. 2, figs. 1 and 2 (vide *Labeobarbus nedgia* Rüpp., 1837).
- Barbus gorguarii* Rüpp., 1837, *Mus. senckenb.* **2** : 9, pl. 1, fig. 4 ; Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 424 ; Blgr., 1907, *Fish Nile* : 237, pl. 44 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 75, fig. 53.
- Barbus gorguarii macrophthalmus* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 177, pl. 12, fig. 2.
- Barbus elongatus* Rüpp., 1837, *Mus. senckenb.* **2** : 11, pl. 2, fig. 1.
- Labeobarbus nedgia* Rüpp., 1837, *Mus. senckenb.* **2** : 14, pl. 2, fig. 3.
- Barbus nedgia* (Rüppell) : Günther, 1868, *Cat. Fish* **7** : 104 ; Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 426 ; Blgr., 1907, *Fish Nile* : 223, pl. 41, fig. 2 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 51, fig. 32.
- Barbus gregorii* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 422 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 45.
- Barbus rueppelli* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 427 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 26, fig. 7.
- Barbus macronema* Blgr., 1902, *Ann. Mag. Nat. Hist.* (7) **10** : 427 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 25.
- Barbus macronema* var. *parenzani* Zolezzi, 1940, *Boll. Pesca. Piscic. Idrobiol.* **15** : 372.
- Barbus harringtoni* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 429 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 61, fig. 40.
- Barbus plagiostomus* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 429 ; Blgr., 1907, *Fish Nile* : 232, pl. 38, fig. 2 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 68, fig. 47.
- Barbus jarsinus* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 429 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 62, fig. 41.
- Barbus platystomus* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 430 ; Blgr., 1907, *Fish Nile* : 234, pl. 40, fig. 2 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 73, fig. 51.
- Barbus platystomus* var. *vatovae* Zolezzi, 1939, *Boll. Pesca. Piscic. Idrobiol.* **15** : 370.
- Barbus platystomus platystomus* : Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 170, pl. 8, fig. 1.
- Barbus platystomus daga* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 171, pl. 8, fig. 2.
- Barbus platystomus dekkensis* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 172, pl. 9, fig. 1.
- Barbus platystomus prognathus* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 173, pl. 9, fig. 2.
- Barbus brevibarbis* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 431 ; Blgr., 1907, *Fish Nile* : 219, pl. 35, fig. 2 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 49, fig. 29.
- Barbus kassamensis* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 431 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 30, fig. 11.
- Barbus oreas* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 432 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 38, fig. 19 ; Pietschmann, 1913, *Jb. Ver. Naturk. Wiesbaden* **66** : 189.
- Barbus leptosoma* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 432 ; Blgr., 1907, *Fish Nile* : 220, pl. 40, fig. 1 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 50, fig. 30.
- Barbus duchesnii* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 433 ; Pellegrin, 1905, *Bull. Mus. Hist. nat. Paris* **11** : 291 ; Blgr., 1907, *Fish Nile* : 208, pl. 35, fig. 1 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 31, fig. 12.
- Barbus duchesnii maximus* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 165, pl. 4, fig. 2.
- Barbus duchesnii ibridus* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 166, pl. 5.
- Barbus mento* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 434 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 41, fig. 22.

- Barbus hursensis* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 434 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 46, fig. 27.
- Barbus degeni* Blgr., 1902, *Ann. Mag. nat. Hist.* (7) **10** : 435 ; Blgr., 1907, *Fish Nile* : 222, pl. 41, fig. 1 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 50, fig. 31.
- Barbus degeni leptorhinus* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 164, pl. 3, fig. 2.
- Barbus erlangeri* Blgr., 1903, *Proc. zool. Soc. Lond.* (2) : 329, pl. 29 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 29, fig. 10.
- Capoeta bingeri* Pellegrin, 1905, *Bull. Mus. Hist. nat. Paris* **11** : 292.
- Barbus ilgi* Pellegrin, 1905, *Bull. Mus. Hist. nat. Paris* **11** : 293.
- Barbus neuwillii* Pellegrin, 1905, *Bull. Mus. Hist. nat. Paris* **11** : 294.
- Barbus zuaicus* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 562 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 64, fig. 43.
- Barbus macmillani* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 562 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 67, fig. 46.
- Barbus zaphiri* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 563 ; Blgr., 1907, *Fish Nile* : 235, pl. 45, fig. 1 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 74, fig. 52.
- Barbus bottegi* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 563 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 70, fig. 48.
- Barbus gudaricus* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 564 ; Blgr., 1907, *Fish Nile* : 241, pl. 34, fig. 2 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 40, fig. 21.
- Barbus eumystus* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 565 ; Blgr., 1907, *Fish Nile* : 215, pl. 38, fig. 1 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 44, fig. 25.
- Barbus margaritae* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 565 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 39, fig. 20.
- Barbus alticola* Blgr., 1906, *Ann. Mag. nat. Hist.* (7) **17** : 566 ; Blgr., 1911, *Cat. Afr. Fish* **2** : 55, fig. 35.
- Barbus bingeri* : Blgr., 1911, *Cat. Afr. Fish* **2** : 69.
- Barbus procatopus* Blgr., 1916, *Ann. Mag. nat. Hist.* (8) **17** : 244.
- Barbus volpinii* Parenzan, 1940, *Boll. Idrobiol. Cacc. Pesca. Afr. orient. ital.* **1** : 9, fig. 1.
- Barbus brunellii* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 173
- Barbus brunellii acutirostris* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 174.
- Barbus dainellii* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 175.
- Barbus dainellii macrocephalus* Bini, 1940, *Missione Stud. Lago Tana*, **3** (2) : 176.
- Varicorhinus bingeri* : Bertin and Estève, 1947, *Catalogue des Types des Poissons*, Paris **4** : 44.

NOTES ON THE SYNONYMY. Although the specific name *surkis* appears before *intermedius* in Rüppell (1837), I have selected the latter name as the senior synonym according to article 24 of the International Code. The reasons for this are : a) Rüppell's text states that *Barbus surkis* has 36 scales in the lateral line but his illustration (pl. 1, fig. 1) shows only 32 scales ; the text and figure of *Barbus intermedius* agree with the holotype ; b) the holotype of *Barbus surkis* is untraceable but the holotype of *Barbus intermedius* exists as specimen 6778 in the Senckenberg Museum, Frankfurt-am-Main ; c) the specific name *intermedius* is a great deal more apposite for this variable species than is *surkis*.

A synonymy as extensive as this, involving 50 nominal species and subspecies and resulting in one species with two subspecies requires a great deal of justification. The evidence will be presented below.

Just over a hundred years after Rüppell described the deep-bodied *Barbus surkis* Bini (1940) described the elongated, predatory-looking *Barbus brunellii*. These two species, ironically the first and (to date) the last described from Lake Tsana, are very different in shape (see figs. 31, 32 and 46) and a simple comparison of an

example of each form would undoubtedly result in their being placed in separate species. It is only when the extremes are compared with other Ethiopian specimens that it becomes evident that one variable species is present instead of many, scarcely distinct species. The degree of variability is great and is reflected throughout many parts of the bodies of species; head length may be singled out as one of the most variable factors. Because of this plasticity of form it has proved impossible to detect more than two statistically recognizable groups within the whole sample. It had been suspected by Worthington (1932a) that this would be the case from the practical difficulties he encountered in trying to distinguish one nominal species from another using the published descriptions.

The majority of species were described between 1902 and 1906, usually from a very few, often poorly preserved specimens. The species were defined on the basis of small differences in barbel lengths, lip formation, scale counts and body proportions; differences that may be tenable with few specimens but lose their significance with a large series. Subsequent workers have tried with increasing difficulty to fit newly acquired specimens into the framework of species established by Boulenger (1911a, 1916). Bini (1940) reduced several of Boulenger's species to subspecific rank but at the same time described a further two species. Worthington (1932a: 127) from his work on the Kenyan and Ugandan lakes prophetically commented, 'thus, when a large series of specimens is collected from Lake Tsana and the upper tributaries of the Blue Nile, it is probable that the series of species endemic to the region - *Barbus leptosoma*, *Barbus degeni*, *Barbus nedgia* etc., will prove to be one and the same species since they differ from each other almost solely in the degree of lip development and in the size of the eye and dorsal spine'.

The graphs and calculations presented below will, I hope, show the essentially normal distributions of the characters heretofore considered trenchant, and that it is biologically more reasonable to suggest the presence of one variable species rather than a multitude of almost indistinguishable, ill-defined or indefinable species.

The illustrations reproduced from Boulenger (1911a) and Bini (1940) will help to supplement the calculations and show the various intergrades between the most extreme forms.

Worthington (1932a: 124) noted that the fishes listed by Boulenger (1911) as *Barbus bynni* from Lake Baringo should be placed with *Barbus gregorii* (= *Barbus intermedius*).

Mann (1971) suggests that *Barbus gregorii* from Lake Baringo is rightfully placed with *Barbus tanensis* (= *Barbus oxyrhynchus*). His comparative material was limited to small fishes (less than 60 mm S.L.) which can give rise to misleading conclusions if compared with larger fish. In the scale counts, nature of the scale striae and in most morphometric details the Lake Baringo fishes are identical with *Barbus intermedius* from Ethiopia. However, the dorsal spine is modally longer than in the other *Barbus intermedius* populations (although the spine is not as thick as in *Barbus tanensis*) and the pectoral fin is longer. Because of these characters and because Lake Baringo is isolated and the most southern locality for this species, I think it would be valid to accord sub-specific status to the *Barbus intermedius* population in Lake Baringo and I propose the name *Barbus intermedius australis*.

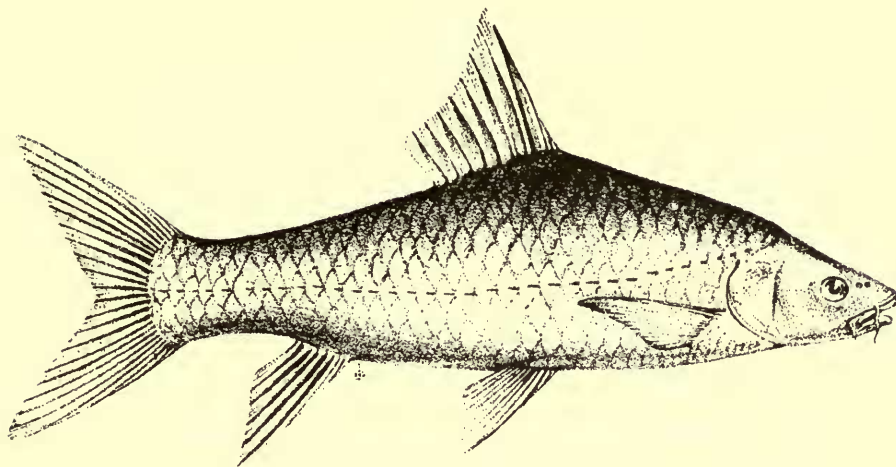


FIG. 30. *Barbus intermedius* (Holotype from Rüppell 1837).

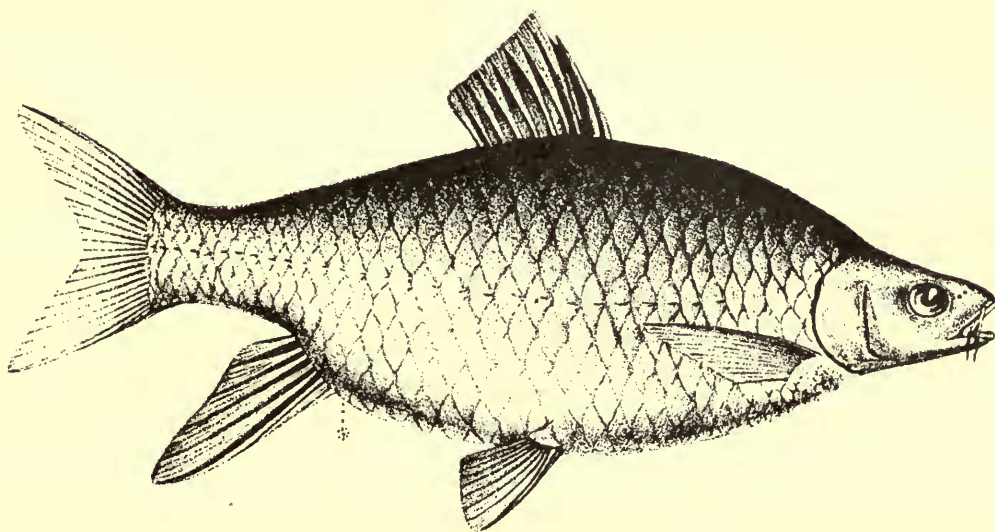


FIG. 31. *Barbus intermedius* (Holotype of *B. surkis* from Rüppell 1837).

It is perhaps worth noting that the longer dorsal spine and longer pectoral fin which distinguish the Lake Baringo population are two characters possessed in greater degree by *Barbus oxyrhynchus*.

HOLOTYPE. A dried specimen of 296 mm S.L. No. 6778, Senckenberg Museum, Frankfurt-am-Main.

DESCRIPTION. The description is based on a total of 454 specimens; 179 from Lake Tsana, 58 from Lake Baringo, 44 from Lake Abaya, 32 from Lake Zwai, 32 from the Hawash river, 30 from Lake Stephanie, 29 from the Blue Nile, 24 from

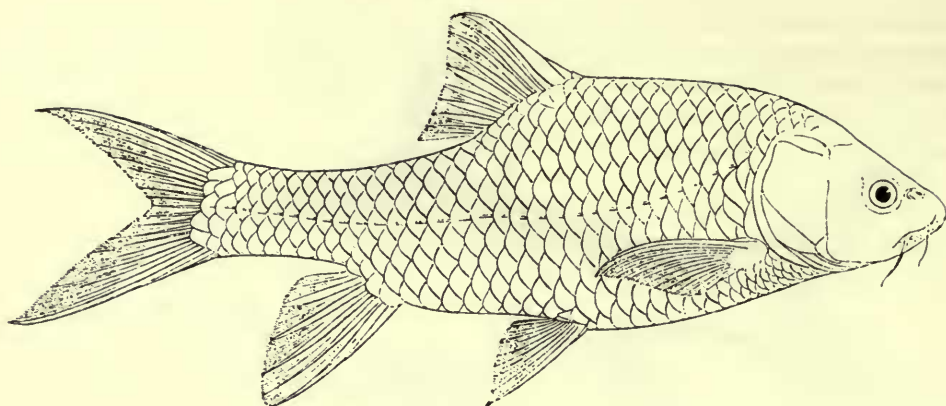


FIG. 32. *Barbus intermedius* (figure of *B. surkis* from Boulenger 1911a).

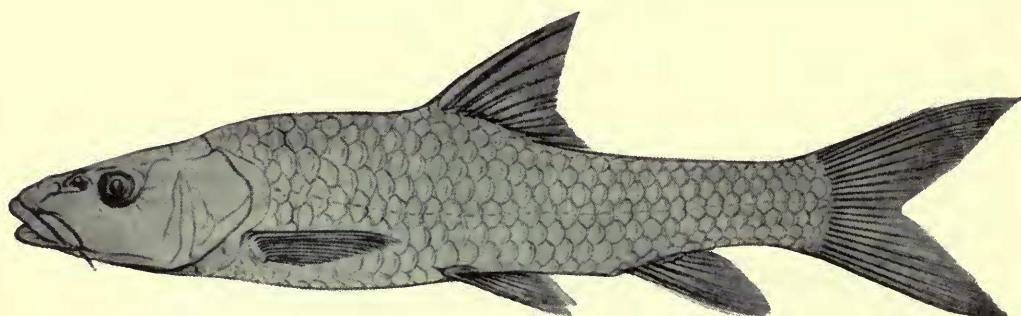


FIG. 33. *Barbus intermedius* (Holotype of *B. dainellii* from Bini 1940).

Lake Rudolf and the Omo river, 21 from the Webi Shebeli river, four from Lake Langano and one from Lake Orsodi.

All traceable holotypes have been examined ; those not seen were *Barbus surkis* (Frankfurt, missing since the war), *Barbus volpinii* (not traceable), *Barbus macronema* var. *parenzani* (not traceable) and *Barbus dainellii* (lost through poor preservation).

	n	\bar{x}	s.d.	s.e.	range
L	454				66 - 489 mm
D	454	28.4	2.3	0.1	20.7-37.7
H	454	26.4	2.2	0.1	19.0-31.7
I	454	5.9	1.2	0.05	3.5-10.2
IO	454	8.0	0.8	0.03	4.7-12.3
MW	450	5.9	1.0	0.04	3.6- 9.1
Pct	452	21.8	1.8	0.1	15.6-28.0
CP1	454	16.9	1.6	0.1	11.7-22.9
CPd	453	11.6	1.2	0.1	8.0-15.0
Snt	454	8.5	1.1	0.05	5.5-12.7
Ab	449	5.8	1.9	0.1	1.8-11.1
Pb	451	6.9	2.1	0.1	1.9-12.1

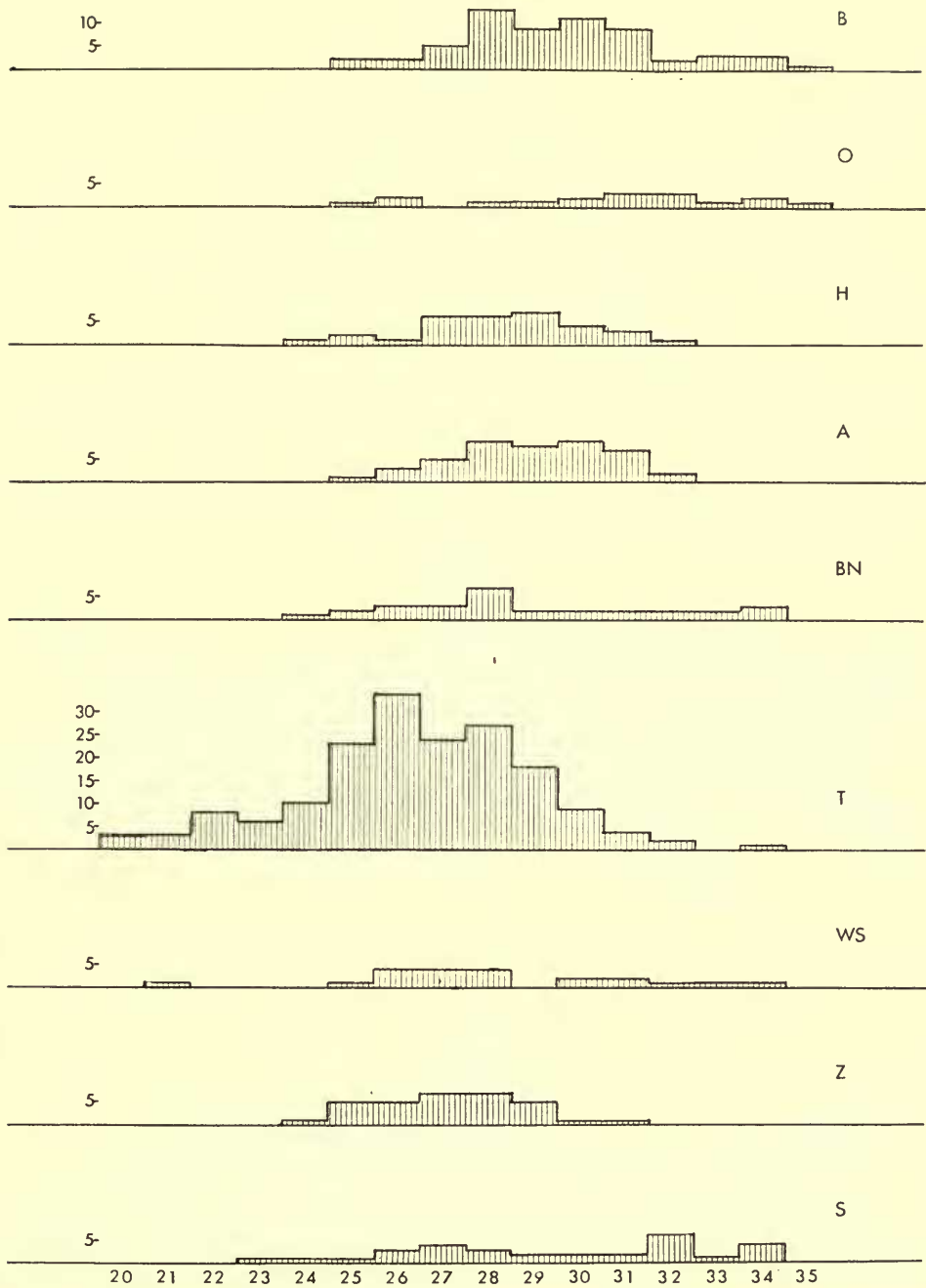


FIG. 34. Histograms of the distribution of the body depth (as a percentage of the standard length) in *B. intermedius* populations from various localities. B = Lake Baringo; O = Omo river; H = Hawash river; A = Lake Abaya; BN = Blue Nile; T = Lake Tsana; WS = Webi Shebali River; Z = Lake Zwai; S = Lake Stephanie.

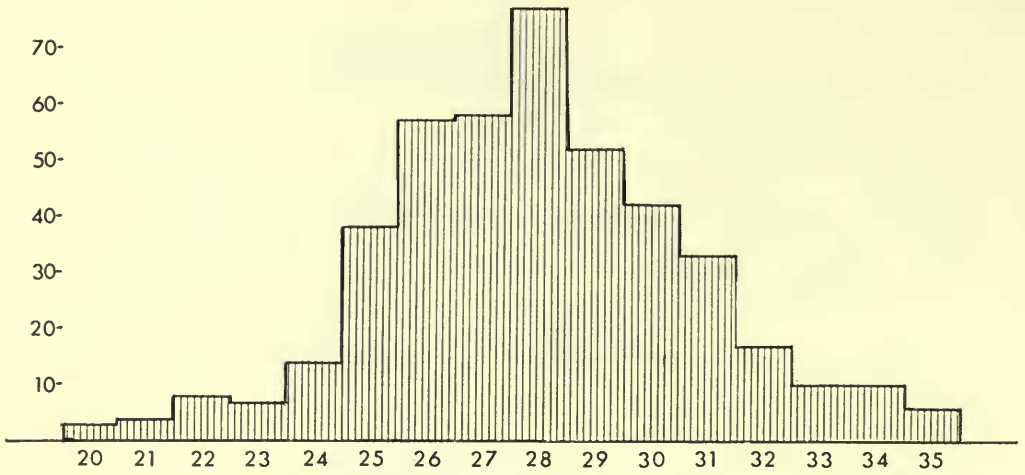


FIG. 35. *Barbus intermedius*: a composite histogram of the body depth for specimens from all the localities treated separately in Fig. 34. The distribution of body depth throughout the whole *B. intermedius* sample is normal.

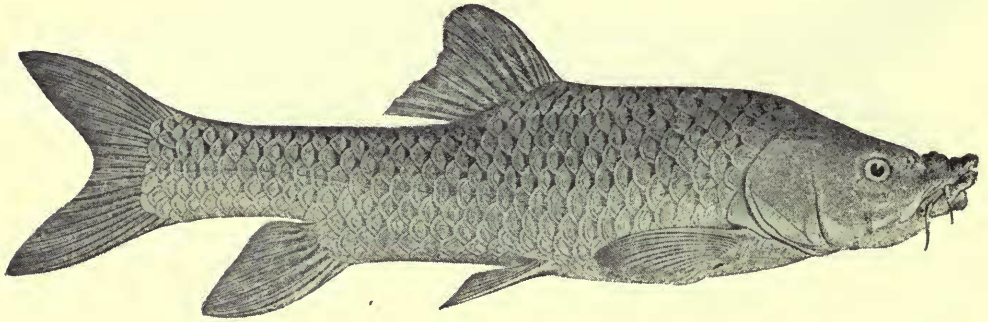


FIG. 36. *Barbus intermedius* (Holotype of *B. degeni* from Boulenger 1911a).

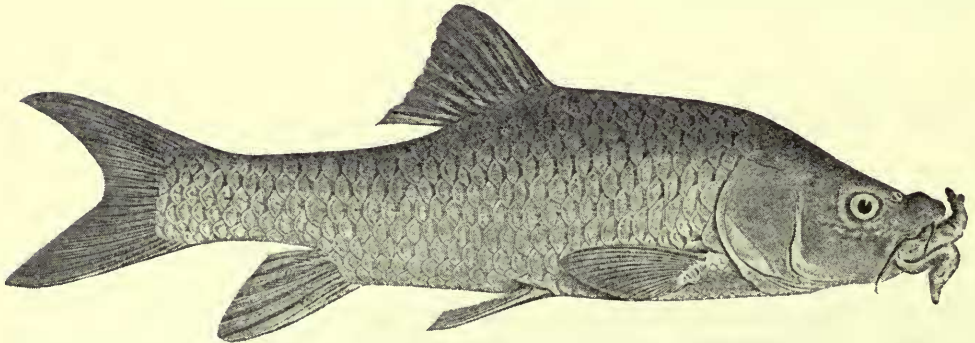


FIG. 37. *Barbus intermedius* (figured specimen of *B. nedgia* in Boulenger 1911a).

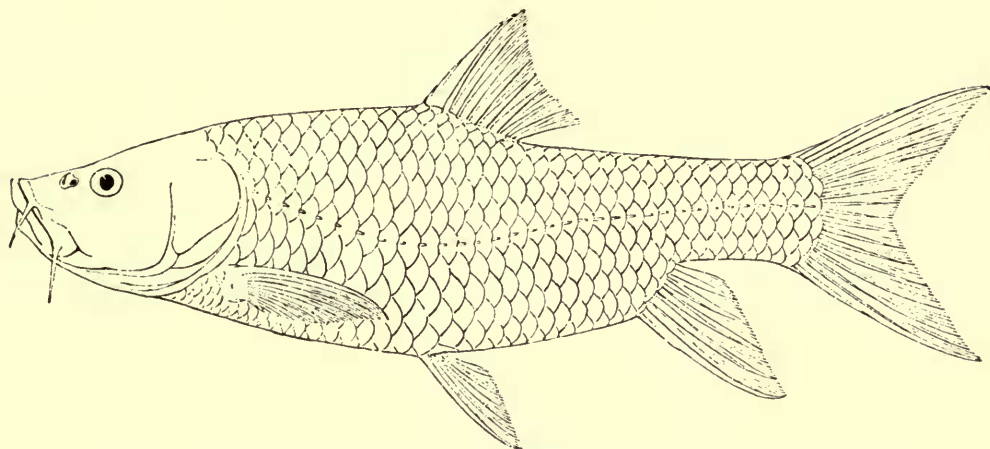


FIG. 38. *Barbus intermedius* (Holotype of *B. rueppelli* in Boulenger 1911a).

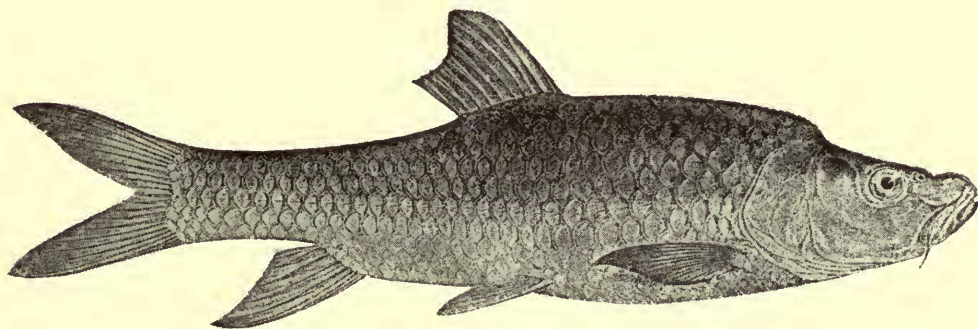


FIG. 39. *Barbus intermedius* (figured specimen of *B. gorguarii* from Boulenger 1911a).

The morphometric data do not adequately reflect the variation in body form shown by this species. A series of examples of different facies is shown in figs. 36 to 44. Names synonymized above are used below for convenience.

The body varies in shape from the slender *Barbus dainellii* form (fig. 33) to the deep *Barbus surkis* form (fig. 32). It can be seen, though, from the histograms that in the whole sample the body depth has a normal distribution (figs. 34, 35). There is a little difference in body depth distribution in different localities, e.g. the Lake Tsana population is modally less than the Lake Baringo and Omo river populations.

The mouth and lips exhibit a considerable degree of variation. 'Rubber-lipped' forms are common, e.g. the forms described as *Barbus degeni* (fig. 36) and *Barbus nedgia* (fig. 37). *Barbus rueppelli* (fig. 38) and *Barbus gorguarii* (fig. 39) have large mouths with the gape at 45 degrees to the horizontal; however, *Barbus kassamensis* (fig. 40) and *Barbus hursensis* (fig. 41) link this mouth type with the ventral or sub-terminal mouths of the forms referred to *Barbus oreas* (fig. 42) and *Barbus erlangeri* (fig. 43). The ventral mouth with a horny lower lip is found in *Barbus macmillani*

(fig. 44) and *Barbus bingeri*. Although the differences seem quite distinct when isolated examples are considered, examination of a large number of specimens shows that the mouth types grade into each other without any sharp divisions. The form of the mouth in this species is valueless as a taxonomic character.

Four barbels are invariably present ; the Lake Stephanie population has modally slightly longer barbels than any other population, but this is very possibly a reflection of the size range of the sample. The barbels are relatively smaller in larger fishes, partly because of negative allometry and partly because of the increased chance of physical damage. Histograms of the barbel length in different populations are shown in fig. 45. The head length varies considerably. The forms with

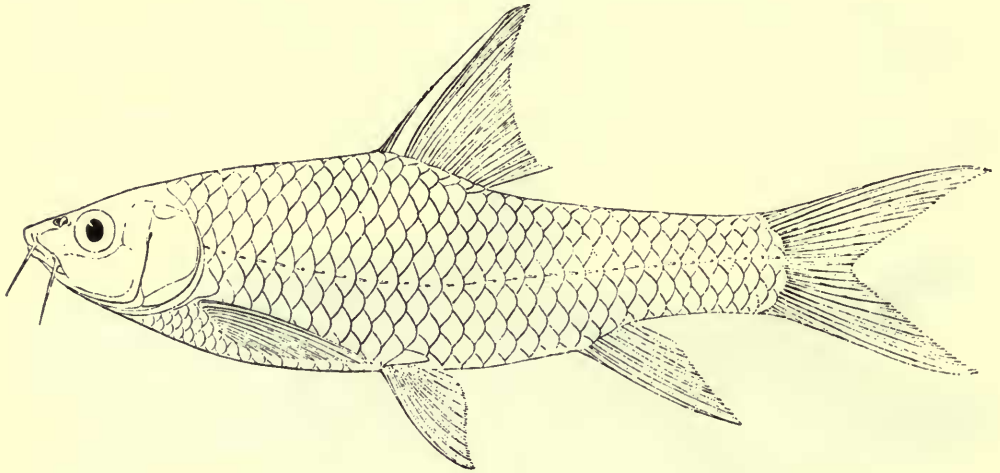


FIG. 40. *Barbus intermedius* (Holotype of *B. kassamensis* Boulenger 1911a).

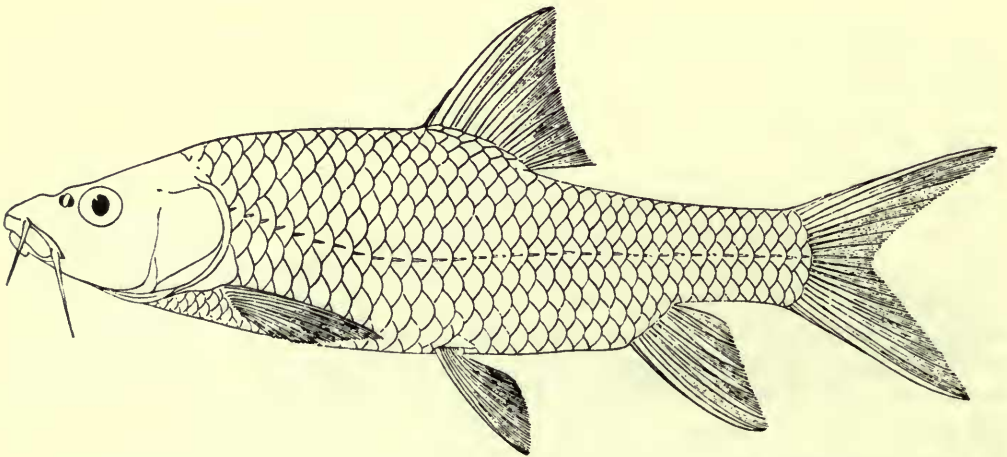


FIG. 41. *Barbus intermedius* (Holotype of *B. hursensis* from Boulenger 1911a).

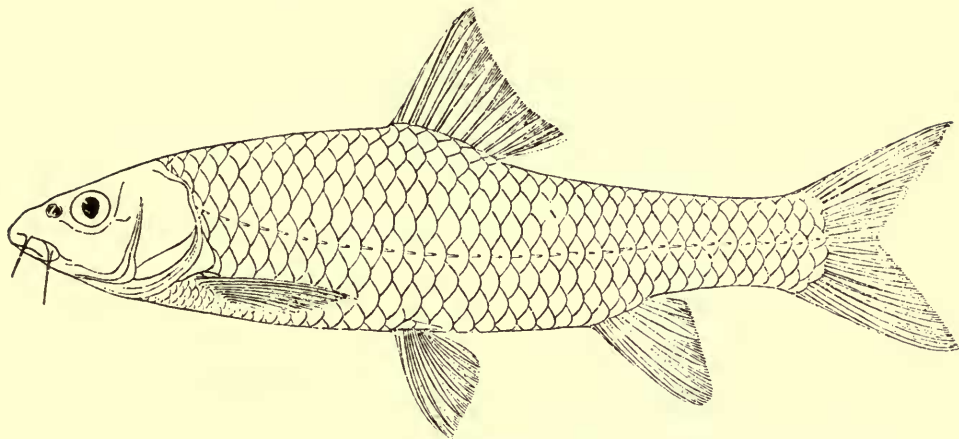


FIG. 42. *Barbus intermedius* (Holotype of *B. oreas* from Boulenger 1911a).

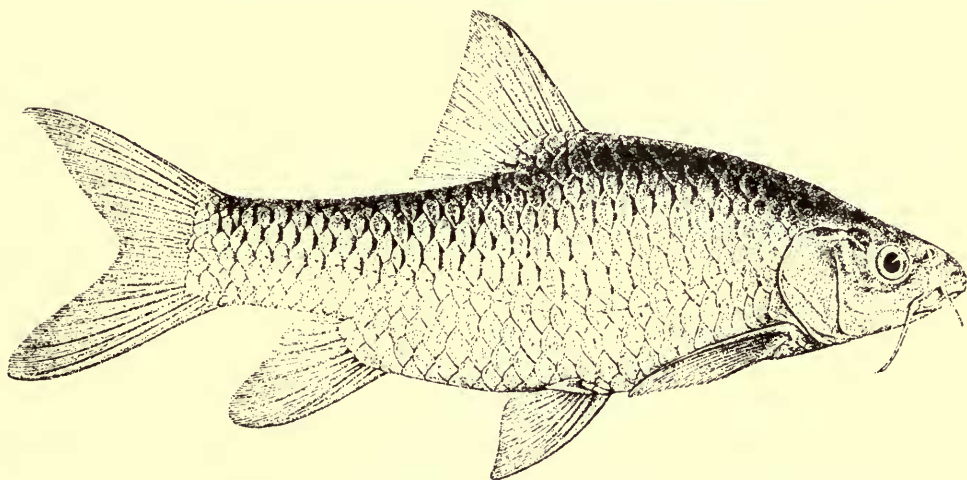


FIG. 43. *Barbus intermedius* (Holotype of *B. erlangeri* from Boulenger 1911a).

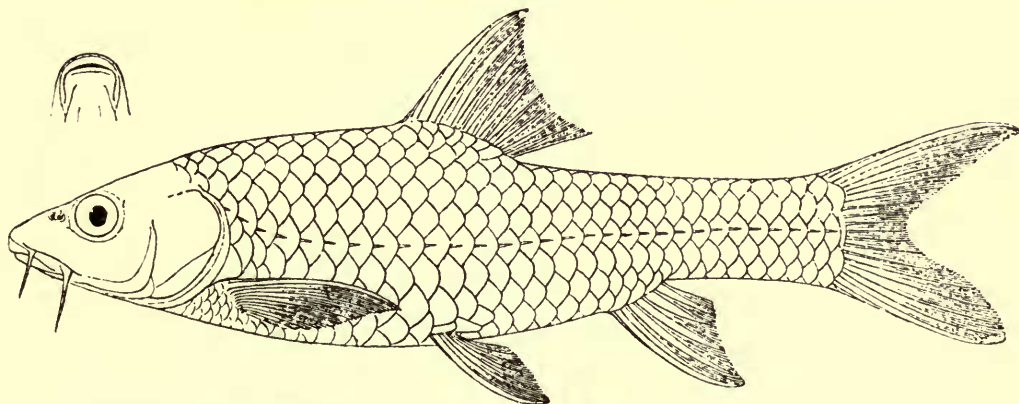
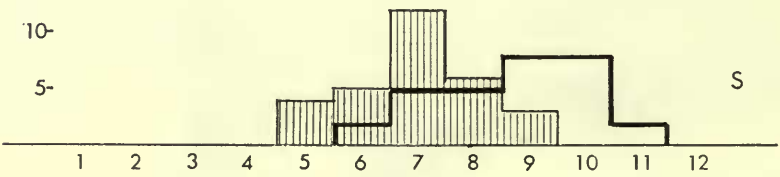
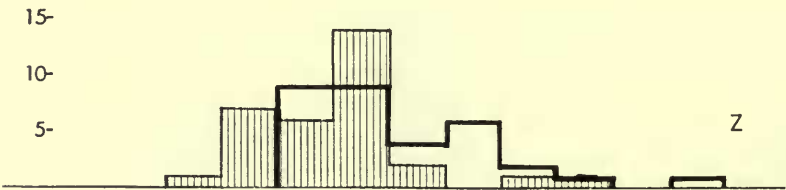
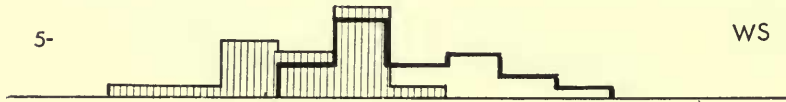
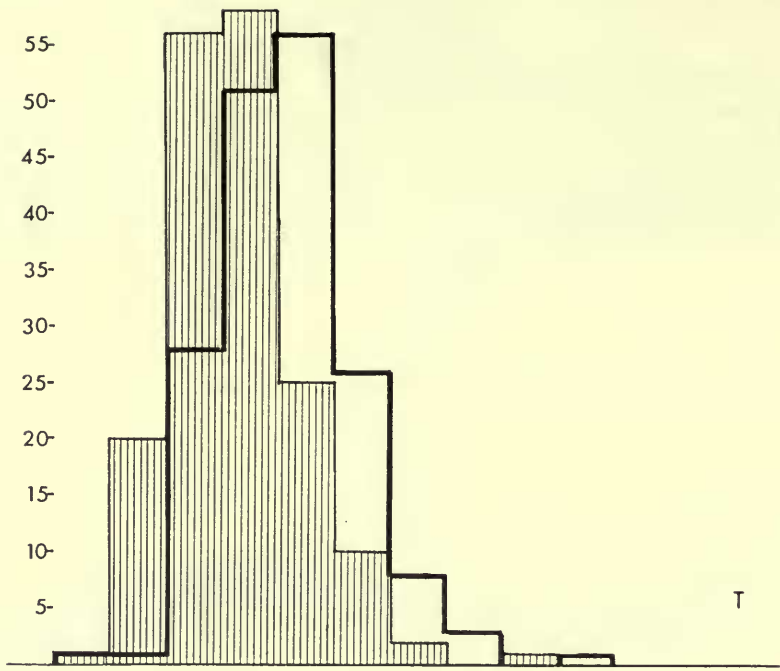


FIG. 44. *Barbus intermedius* (Holotype of *B. macmillani* from Boulenger 1911a).



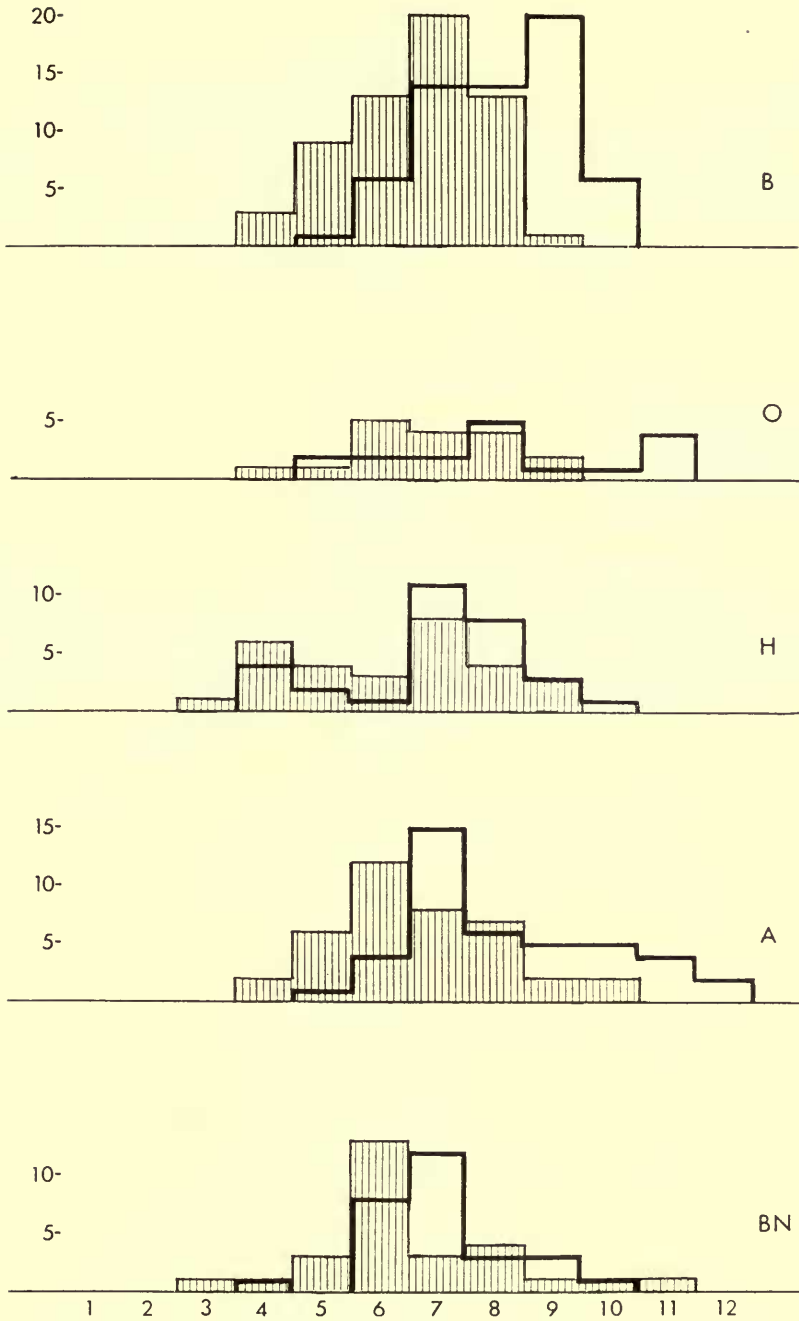


FIG. 45. Histograms of the distribution of the anterior and posterior barbel lengths in *Barbus intermedius* populations from various localities. The lengths are expressed as percentages of the standard length. The shaded column represents the anterior barbel. The locality codes are as in Fig. 34.

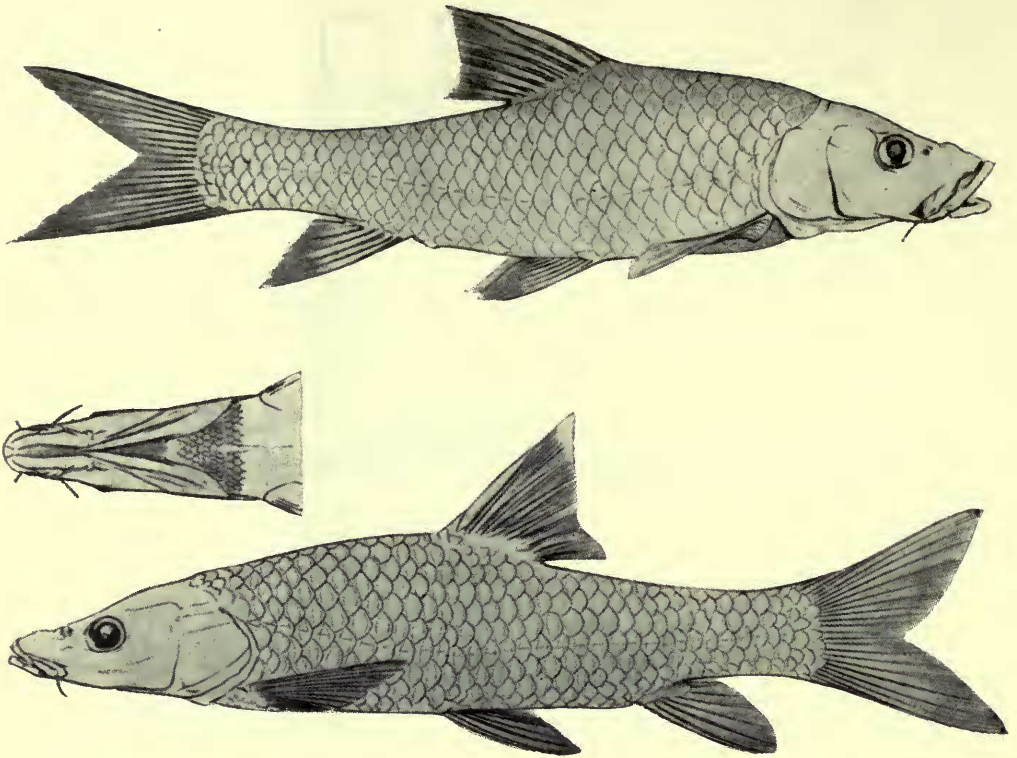


FIG. 46. *Barbus intermedius* (figured examples of *B. brunelli* (above) and *B. brunelli acutirostris* from Bini 1940).

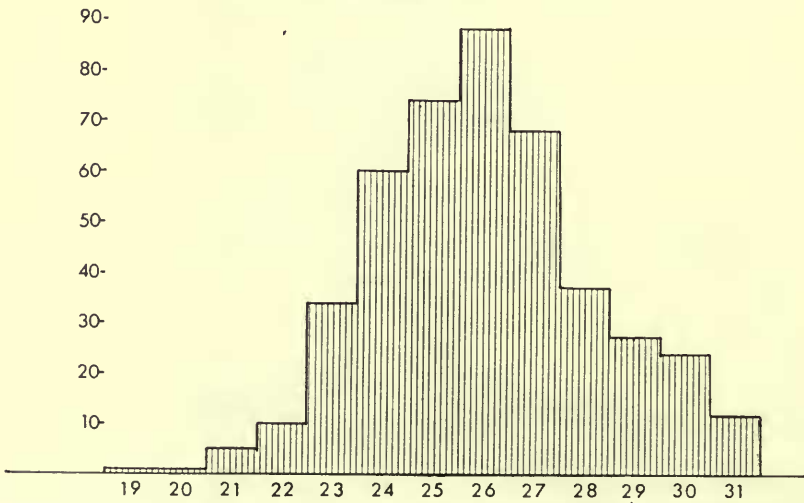


FIG. 47. Histograms of the distribution of the head length expressed as a percentage of the standard length for the entire *Barbus intermedius* sample.

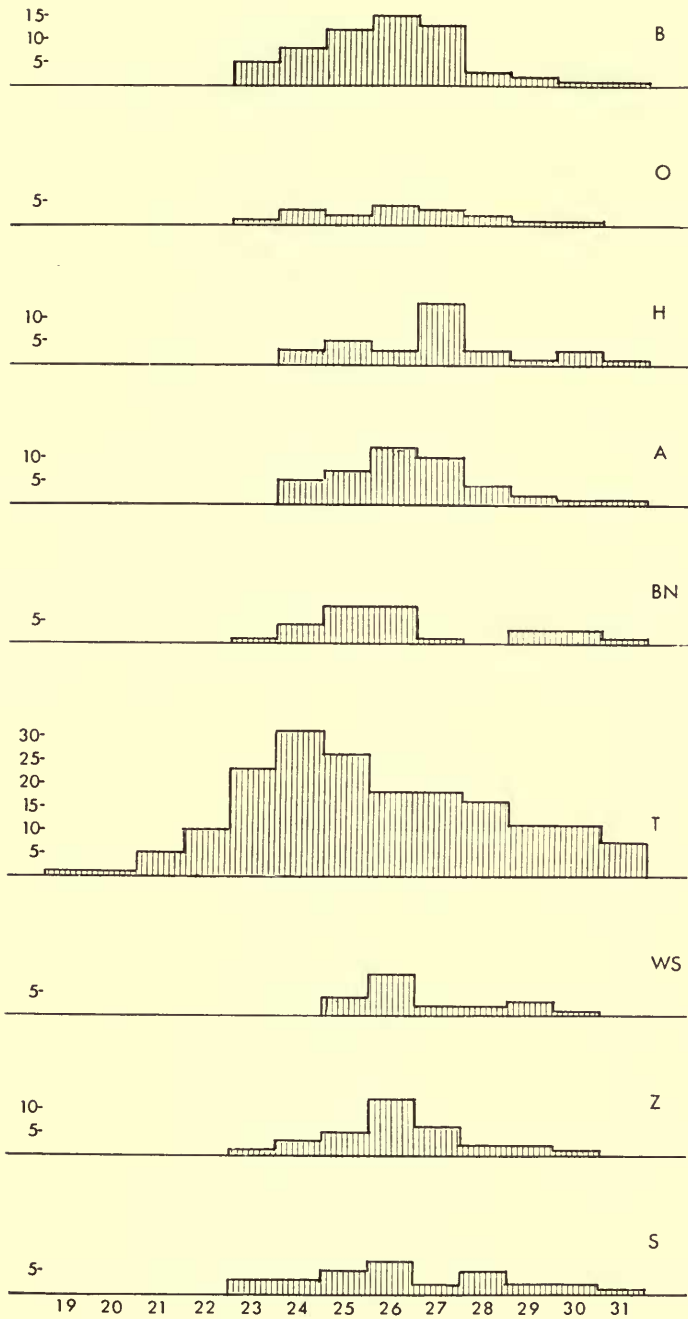


FIG. 48. Histograms of the distribution of the head length expressed as a percentage of the standard length for *B. intermedius* populations from various localities. Locality coding as in Fig. 34.

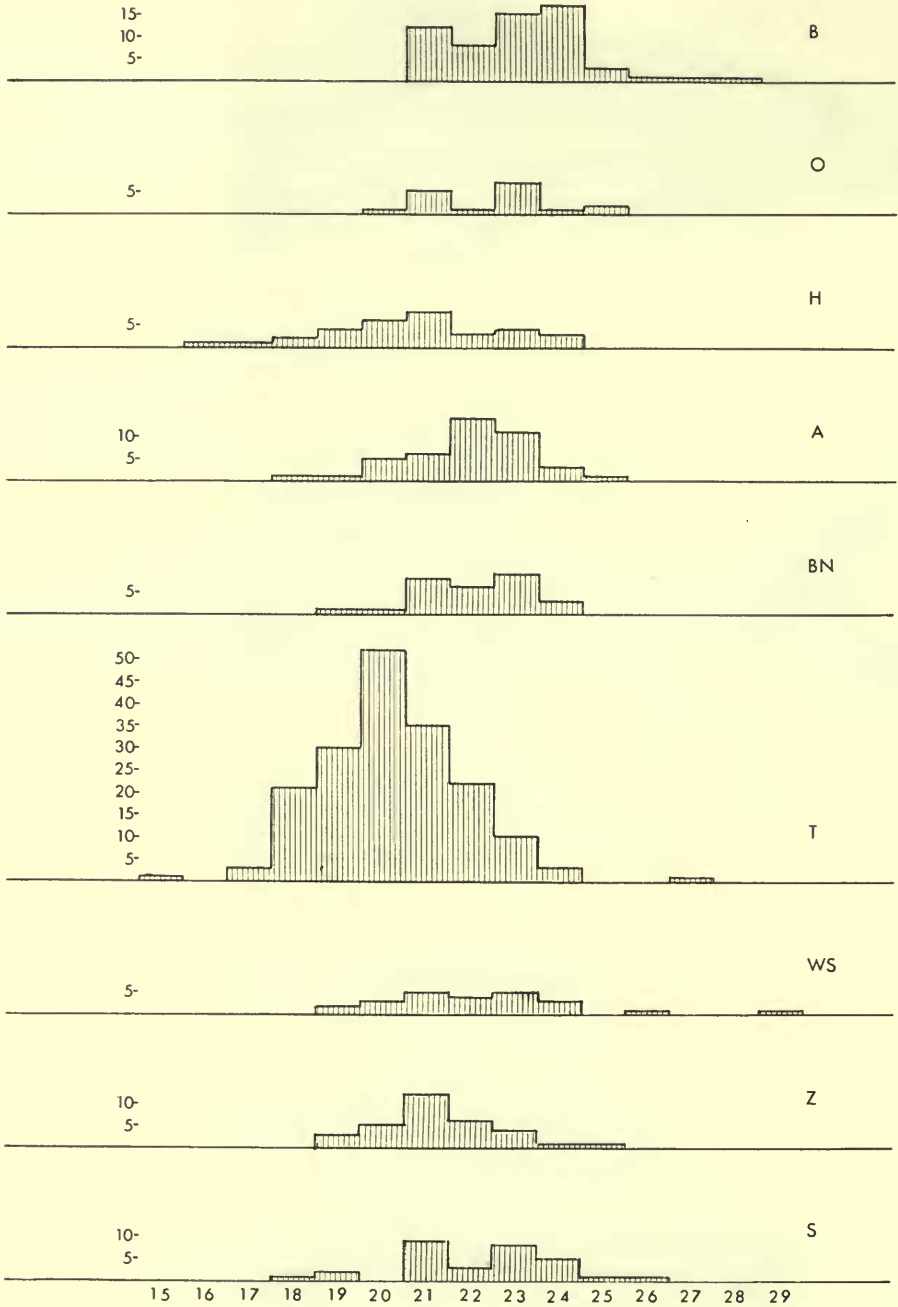


FIG. 49. Histograms of the distribution of the pectoral fin length expressed as a percentage of the standard length in populations from various localities. Locality coding as in Fig. 34.

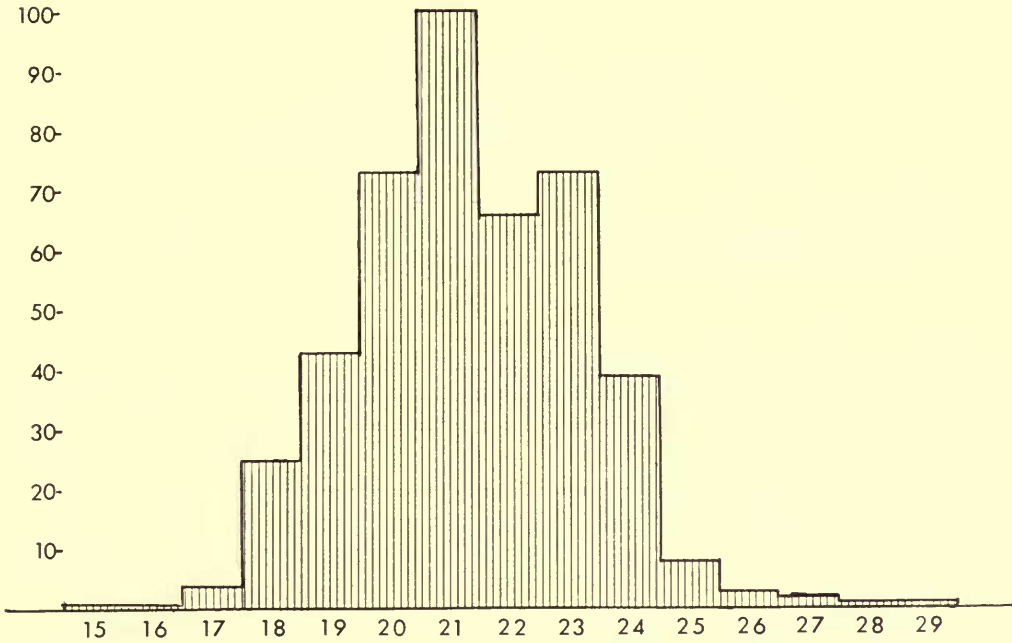


FIG. 50. Histograms of the distribution of the pectoral fin lengths for the entire sample of *B. intermedius*. Lengths are expressed as a percentage of the standard length.

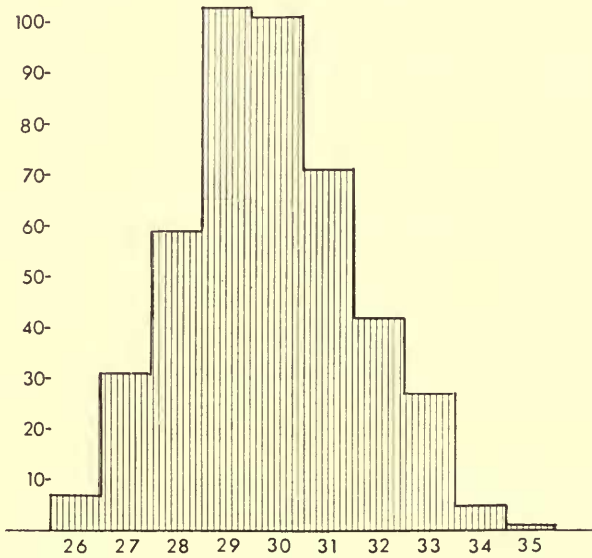


FIG. 51. Histogram of the distribution of the lateral line count for the entire sample of *Barbus intermedius*.

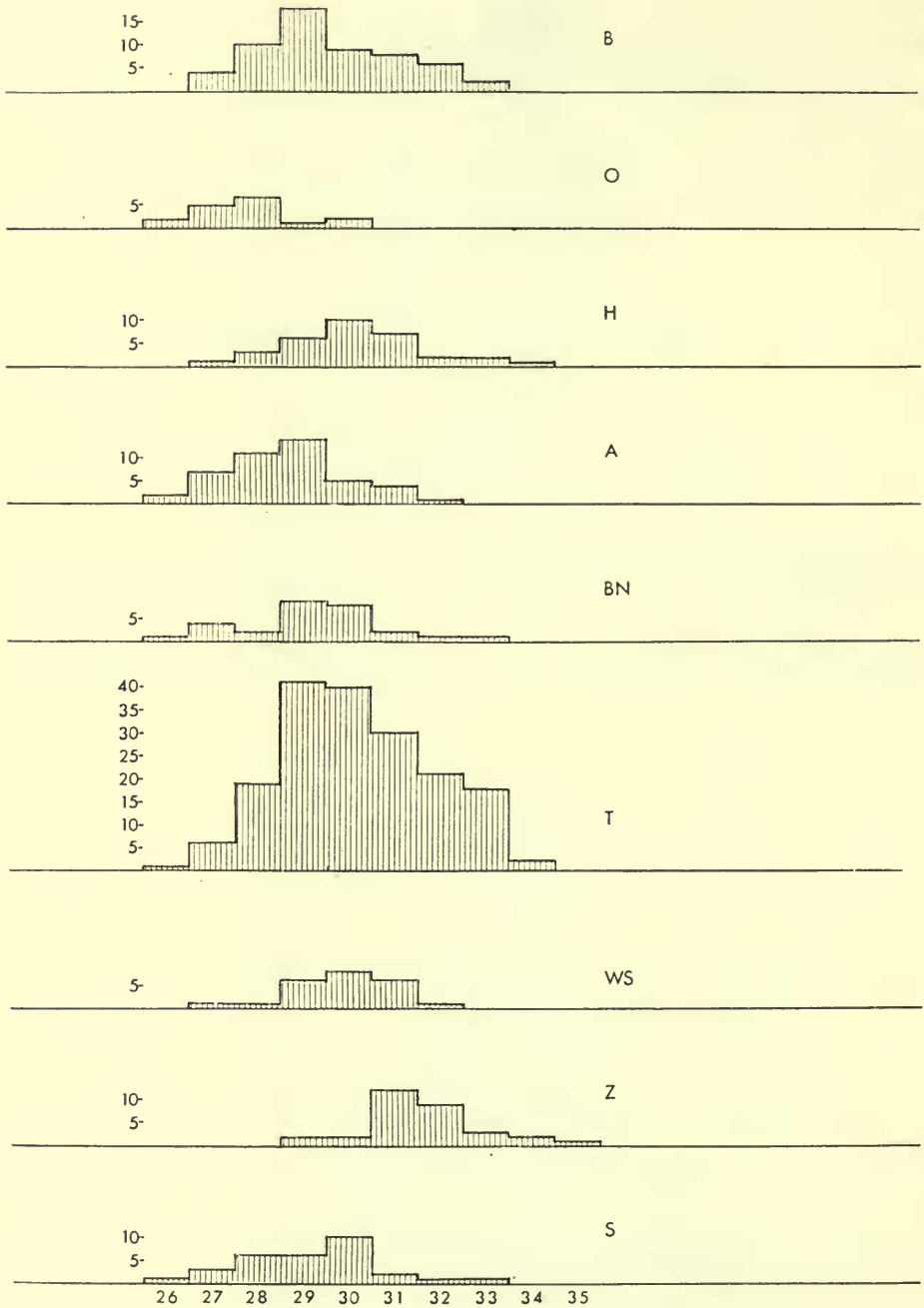


FIG. 52. Histograms of the distribution of the lateral line scale counts of *Barbus intermedius* populations from various localities. Locality coding as in Fig. 34.

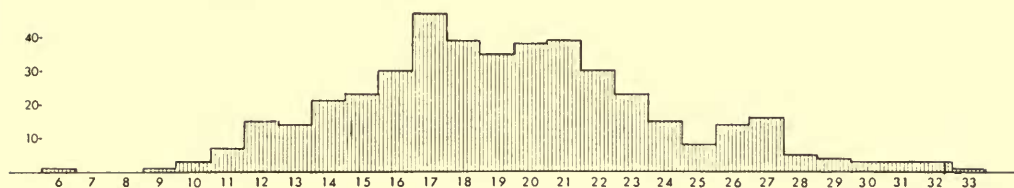


FIG. 53. Histogram of the distribution of the dorsal spine lengths, expressed as a percentage of the standard length of the entire *Barbus intermedius* sample.

the longest heads (*Barbus brunellii*, fig. 46, and *Barbus gorguarii*, fig. 39) are usually large mouthed but the correlation is not perfect. The head length distribution is normal (fig. 47) when the whole sample is considered, but the small samples from some localities, e.g. the Blue Nile, give a chance bimodal or discontinuous distribution (fig. 48). No significance can be attached to this.

The pectoral fin is modally longest in the Lake Baringo sample (fig. 48). The histogram for the entire sample (fig. 50) is bimodal, suggesting a significant difference in the Baringo fishes and these (see below) have been accorded sub-specific status.

Squamation. The scales bear numerous longitudinal striae. The lateral line scale count range for the whole sample is from 26 to 35 (fig. 51). The range and frequencies for each population show no significant variation (fig. 52). The lateral line count is adequate for distinguishing a *Barbus intermedius* sample from a *Barbus altianalis* sample, but is of no value for characterizing the subspecies of *Barbus intermedius*. There are almost always twelve scales around the caudal peduncle. The only exceptions are three specimens from Lake Tsana that have 13. Between the dorsal mid-line and the lateral line there are 4.5 (f.24), 5 (f.1), 5.5 (f.381), 6 (f.2), or 6.5 (f.33) scale rows. Between the lateral line and the ventral mid-line there are 4 (f.1), 4.5 (f.160), 5 (f.2), 5.5 (f.231), 6 (f.1), 6.5 (f.30) or 7.5 (f.1) scale rows. Between the lateral line and the base of the ventral fin there are 1.5 (f.2), 2 (f.9), 2.5 (f.246), 3 (f.41), 3.5 (f.137), 4 (f.1) or 4.5 (f.3) scale rows. The number of scale rows is, not infrequently, different on either side of the specimen and in many cases scales had been lost and it was impossible to count the original number.

Zolezzi (1940) gives 39-40 scales in the lateral line series of *Barbus platystomus* var. *vatovae*. The only specimen in the collections of the Stazione Idrobiologia, Roma (where Zolezzi's specimens were lodged), that is attributed to this variety and is of the same length as Zolezzi's holotype has only 30 lateral line scales on one side and 31 on the other. This specimen is not labelled as type material but agrees with the only specimen described by Zolezzi in all respects except for the lateral line scale count.

Dorsal fin. The origin of the dorsal fin varies from just in front to just behind the vertical to the origin of the pelvic fins.

There are four unbranched rays. The last of these is ossified into a smooth spine, $\bar{x} = 20.1$, s.d. = 4.9, s.e. = 0.2, range 6.9-33.9 (percentage of the S.L.). The range is unusually large and reflects the size range of the specimens examined and

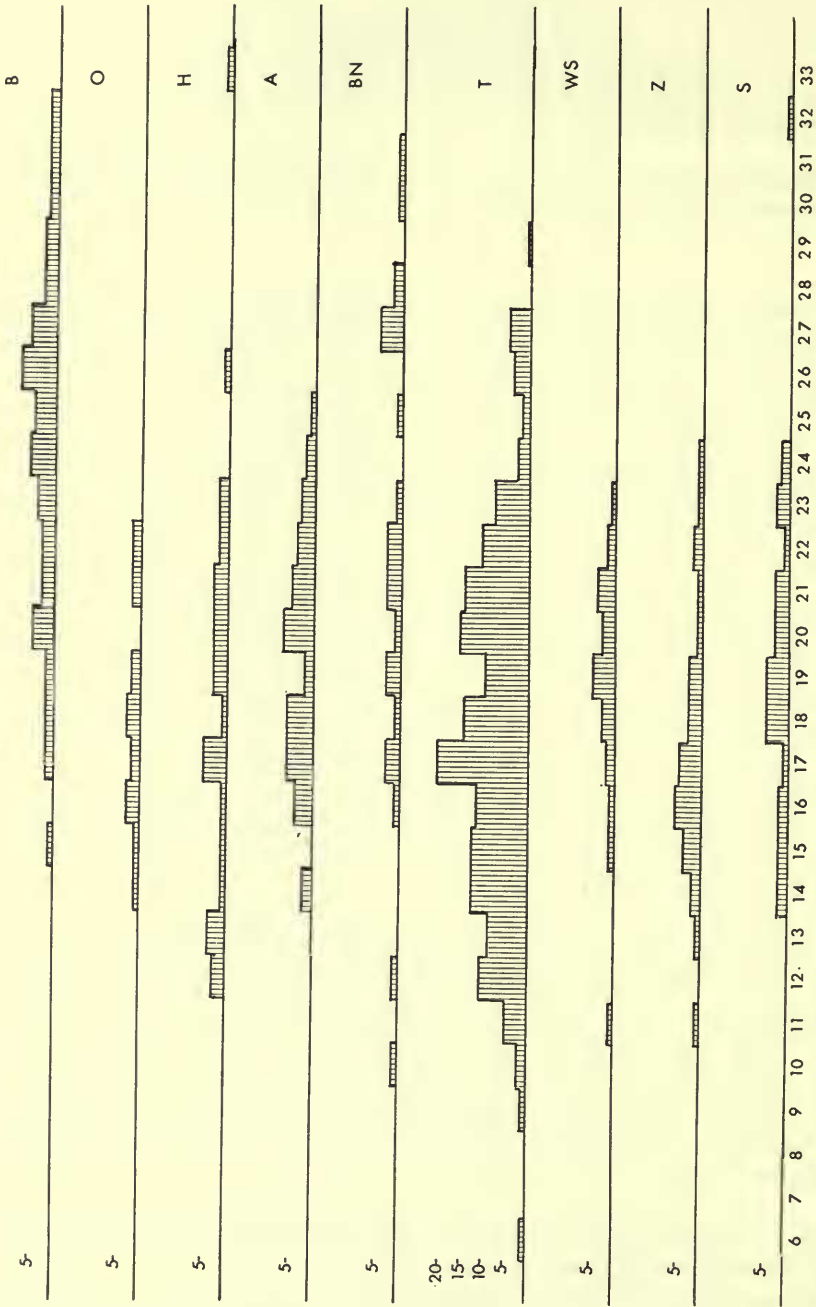


FIG. 54. Histograms of the distribution of the dorsal spine lengths of *Barbus intermedius* populations. Lengths are expressed as a percentage of the standard length. Locality coding as in Fig. 34.

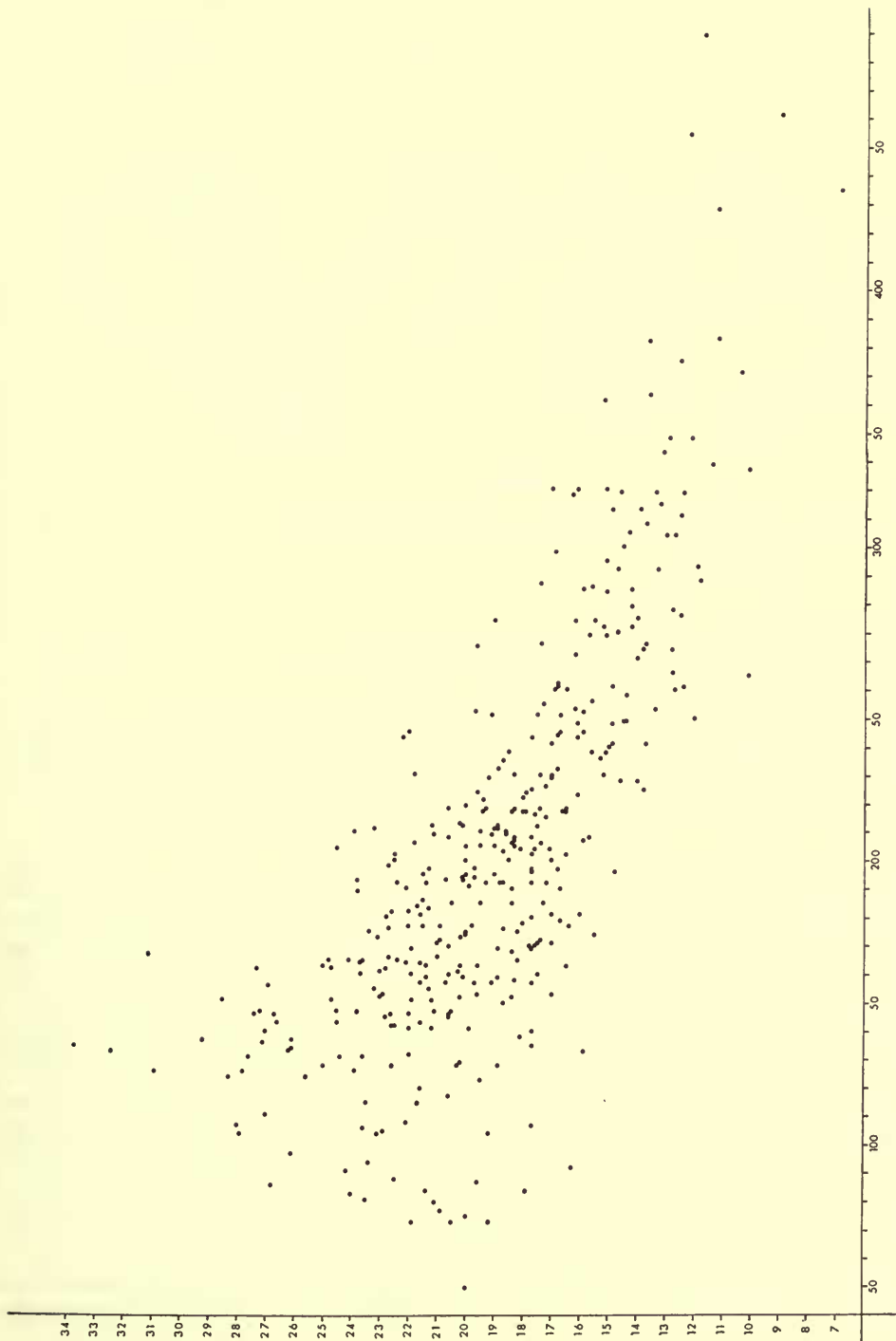


FIG. 55. Scatter diagram of the dorsal spine length as a percentage of the standard length against the standard length for the entire sample of *Barbus intermedius*.

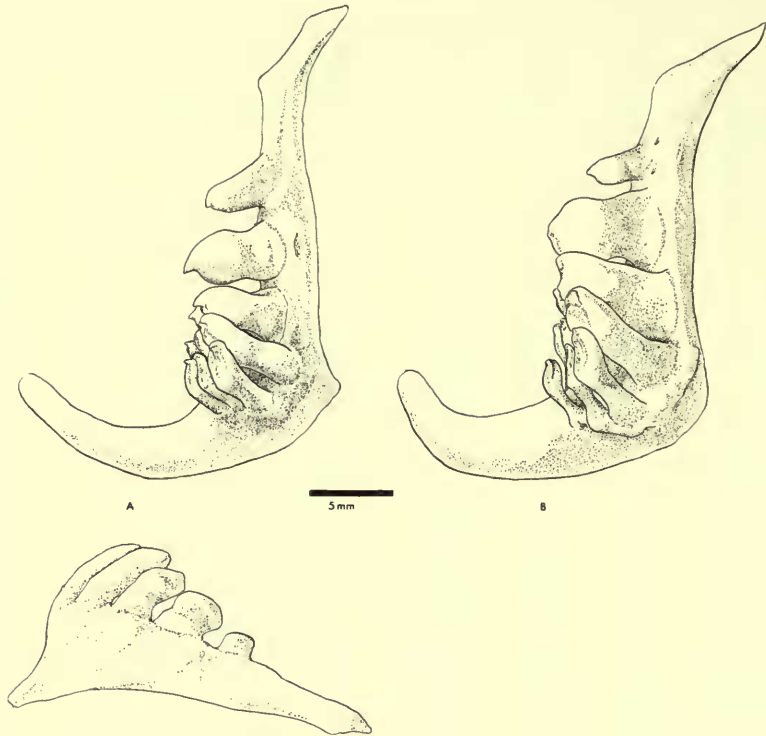


FIG. 56. A comparison of the left pharyngeal bones from a shallow-bodied specimen of, A, *B. intermedius* (previously identified as *B. gorguarii*) of 329 mm S.L. with a deep-bodied specimen, B, (previously identified as *B. macronema*) of 332 mm S.L.

the negative allometry of the dorsal fin spine (see below). A histogram of the distribution of the length of the dorsal fin spine (fig. 53) shows that the whole sample is bimodal. The fishes with the relatively longer spines all came from Lake Baringo (fig. 54). The length of the spine serves as one of the distinguishing characters of this population (see above). Without the Lake Baringo fishes the dorsal spine has a mean length of 19.1 and the same range as in the whole sample (6.9–33.9). These values cover too wide a range to be useful as a diagnostic character. A graph of the dorsal spine length (expressed as a percentage of the S.L.) against the standard length (fig. 55) shows that the spines are relatively shorter in longer fishes. For fish of less than 170 mm S.L. the dorsal spine values are $\bar{x} = 22.6$; s.d. = 3.4; s.e. = 0.3; range 16.3–33.7; for fishes of 171–250 mm S.L., $\bar{x} = 18.9$; s.d. = 2.3; s.e. = 0.2; range 13.8–24.5; for fishes of more than 251 mm S.L., $\bar{x} = 14.2$; s.d. = 2.4; s.e. = 0.2; range = 6.9–19.7.

Almost the same number of specimens have eight branched dorsal fin rays as have nine. No other number was observed except in cases which were obviously the result of physical damage.

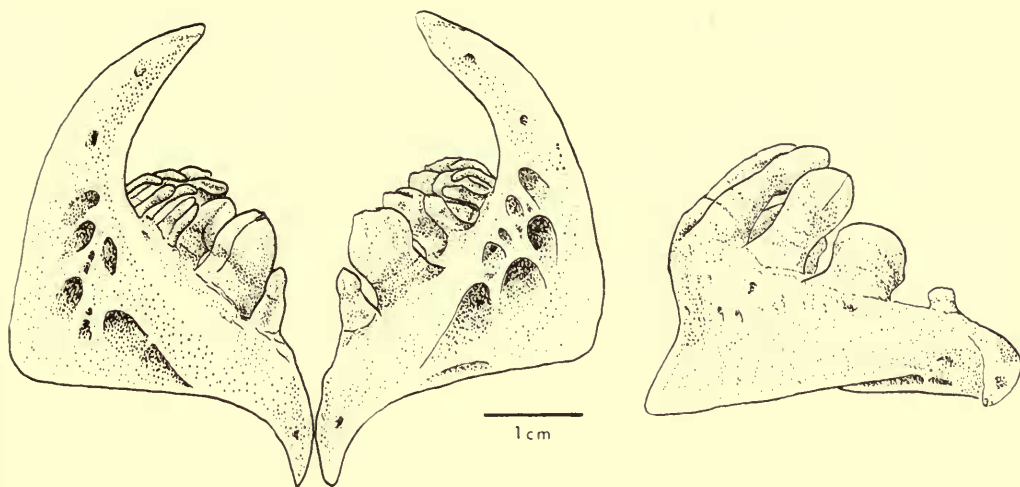


FIG. 57. The pharyngeal bones from a specimen of *Barbus intermedius* (previously identified as *B. surkis*) of 348 mm S.L.

The *anal fin* invariably has three unbranched rays and five branched rays.

The *gill raker* count was only taken on 47 specimens. The range is from 10 to 16 on the lower arm of the first gill arch. The only factor which might have some significance is that the long-headed fishes tend to have 10–12 gill rakers whilst the shorter-headed fishes have 12–16 gill rakers. Not enough specimens were examined to attribute any real significance to this difference.

Pharyngeal bones and teeth. The pharyngeal bones vary in shape. Generally at an equal S.L. fishes with a proportionately longer head have thinner pharyngeal bones than shorter-headed specimens; fig. 56 contrasts the pharyngeals of a specimen of the '*gorguarii*' form, a fish of 329 mm S.L., with the pharyngeals of a specimen of the '*macronema*' form of 323 mm S.L.

An even greater difference is immediately noticeable in the deep-bodied specimens; fig. 57 shows the pharyngeals from a specimen of the '*surkis*' form of 348 mm S.L. The bone in this case is extremely thick and the teeth are molariform. A radiograph of this specimen [B.M. (N.H.) No. 1902.12.13 : 229] shows its stomach to be full of gastropod mollusc shells. Possibly the difference in pharyngeal bone strength reflects differences in diet and age. The left pharyngeal bone of a slender-bodied *Barbus brunellii* is shown in fig. 58.

The pharyngeal teeth number, without exception, 2.3.5.-5.3.2. In fishes < 180–200 mm S.L., the teeth are long with recurved, mammilliform crowns (as shown in fig. 58) whilst larger and bulkier fishes have teeth like those shown in fig. 57. Needless to say these examples are linked by an almost continuous series of intermediate shapes. I am unable to offer anything more than the most tentative elucidation of this variation (see p. 127).

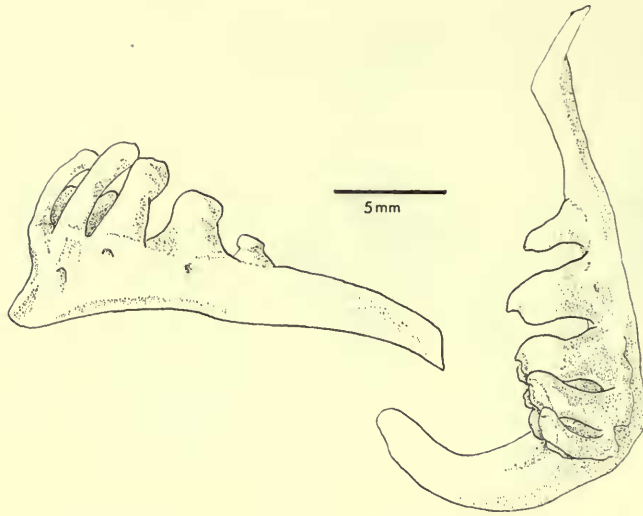


FIG. 58. Pharyngeal bones from a specimen of *Barbus intermedius* (one of Bini's *B. brunellii*).

Little is known about the effect of age and diet upon cyprinid pharyngeal teeth. The range in pharyngeal tooth form shown by *Barbus intermedius* is paralleled to some extent by that in *Barbus altianalis* where the deep-bodied form hitherto referred to *Barbus obesus* possesses singularly massive pharyngeal bones (see p. 14).

Coloration. This is very variable. In life the body colour ranges from silvery-grey to blue, through green, olive and brown, to bronze. Some specimens have been reported with pinkish or yellowish bellies. The fins have been described as whitish tinged with crimson, deep-green, slaty-grey, yellowish and yellow-green. It is quite possible that the colour may be a constant difference distinguishing populations, but there is not enough information available at the moment. In alcohol-preserved specimens the body is grey, brown or bronzy, the scales are usually darker at the base and the fins more or less the colour of the body.

DISTRIBUTION. *Barbus intermedius* is widely distributed throughout Southern Ethiopia and into Northern Kenya, certainly as far as Lake Baringo (fig. 60). It has been recorded from the following rivers: Omo system – Zendo, Gibe, Wondinak and Ergino rivers; Webi Shebéli system – Errer, Jerrer, Iraro and Modjo rivers; Hawash system – Kassam, Hurso, Akaki and Gota rivers; Blue Nile system – Wama, Urgessa, Gudar, Metti, Juju, Didessa and Mogre rivers; Euasso Nyiro system – Uaso Narok; Juba system – Awata river; Lake Zwai basin – Suksuki and Maki rivers; Lakes Abaya and Ganjule basins – Zeissi, Sire, Ganda, Elgo, Alaba and Burka rivers; Lake Stephanie basin – Zuja, Sagan, Gato and Barja rivers; Lake Rudolf basin – Kerio and Ngeng rivers. It has also been recorded from Lakes Zwai, Tsana, Baringo, Langano, Abaya, Ganjule, Orsodi and Stephanie.

There has been a certain amount of confusion over the presence of *Barbus gregorii* (= *Barbus intermedius australis*) in the Athi-Tana system as Mann (1971) noted.

The localities for the syntypes are given by Boulenger (1911a) as: 1 Kiroruma (Upper Tana), Leikipia; 2-4, Guasso el Narua (Baringo), Leikipia; 5-6, Guasso Nyuki (Naiwasha), Njemps Ndogo and a skeleton, 7, Kibwesi river (Athi). All of these specimens were collected by Professor J. W. Gregory's expedition. Mann (*ibid.*) was unable to trace these localities with any certainty, but he points out that the Leikipia plateau drains into the northern Euasso Nyiro and Lake Baringo, not into the Tana system. Gregory (1896) in his account of his travels gives grid references for Guasso Nyuki and Guasso el Narua. The former is a small stream at $0^{\circ}28' N$, $36^{\circ}08' E$, slightly east of south of Lake Baringo, the latter is at the foot of the Leikipia escarpment, to the east of Lake Hannington at $0^{\circ}16' N$, $38^{\circ}18' E$. Guasso Nyuki is nowhere near Lake Naivasha. The map of Gregory's route crosses these rivers at the grid references given. The problem of Kiroruma is not so easily

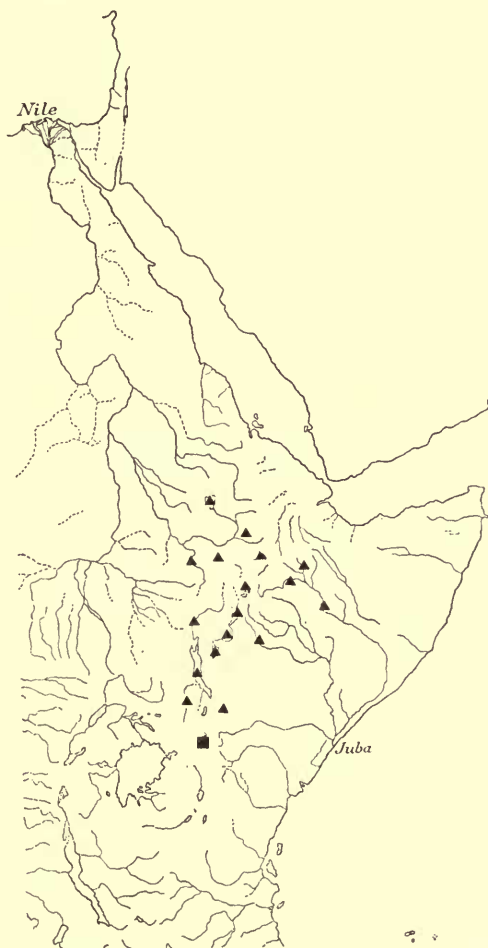


FIG. 59. The distribution of *B. intermedius*: ▲ = *B. intermedius intermedius*,
 ■ = *B. intermedius australis*.

settled. Mann (*ibid.*) says that it is not on any modern maps. Gregory's (*loc. cit.*) gazetteer gives the following information; Kiroruma = Kiloluma $0^{\circ}40' S$, $37^{\circ}30' E$. The river is marked on his map and is in the upper Tana system, parallel to the Thika-Thika river, Gregory's route did not pass through that grid reference (according to his route map) and at the nearest was 24 km away from his location of the Kiroruma river. From Gregory's text (1896: 199) it appears that he was in a great hurry at the time that he was in this area and there is no mention of specimens having been collected. The Kiroruma is separated from the Leikipia escarpment and plateau by Mount Kenya and no specimens of *Barbus intermedius* (*sensu lato*) have been collected from neighbouring rivers in the Tana system (but see below). At the moment this matter cannot be resolved.

Specimen No. 7 of *Barbus gregorii* in Boulenger (1911a: 46) from Kibwesi is another problem. It bears the B.M. (N.H.) Reg. No. 1893.12.2: 36. This number, according to the register, is one of 16 specimens of *Barbus tanensis* (= *Barbus oxyrhynchus*) brought back by the Gregory expedition. *Barbus intermedius* and *Barbus tanensis* were the only *Barbus* spp. brought back by the expedition and they are easy to distinguish, especially so as the specimens are large. The other five specimens bearing the locality Kibwesi are undoubtedly *Barbus tanensis*. This is inexplicable. Three of Gregory's specimens of *Barbus tanensis* were recorded as having come from Guasso el Narua (see above). This species has not been found there since and I am at a loss to explain its alleged presence there. Perhaps the locality was incorrectly recorded, there are enough inconsistencies in this collection to cast a shadow of doubt over some of the localities. The Lake Baringo basin is the most southerly definitive record of *Barbus intermedius*, but further south in the rift valley before the Aberdare mountains and the Maui (or Mau) escarpment lie Lakes Hannington, Elementaita, Nakuru and Naivasha. The first three of these are extremely alkaline. Lake Naivasha according to Worthington (1932b, 1933) and Copley (1948) has a small cyprinodont, *Aplocheilichthys antinorii*, as its only indigenous fish, but *Tilapia nigra* was introduced in 1925 and *Micropterus salmoides* was introduced later. Copley (1948) mentions that no *Barbus* species are present in Lake Naivasha but Parenzan (1939) lists *Barbus gregorii* (= *Barbus intermedius*) as present in the lake. Whether this locality of Parenzan's was based on first-hand evidence or taken from Boulenger's (1911a) list I cannot find out.

The significance of *Aplocheilichthys antinorii* is that it also lives in Southern Ethiopia, i.e. the distribution is similar to that of *Barbus intermedius*. Cooke (1958), in his reconstructions of the lower Pliocene drainage of east Africa, shows volcanic highlands present in the Aberdare region (to the immediate south of Lake Naivasha) and the 'Nile' and 'Athi-Tana' drainage areas much as they are today. This ancient separation of the two watersheds largely precludes the presence of many species in common.

The northern Euasso Nyiro river presents certain problems, not the least of which is the paucity of specimens. From this river in the region of Chanlers Falls come the three *Barbus erlangeri* (= *Barbus intermedius*) specimens whilst from the eastern extremity of the system in the Nero-Narok and Ngau-Narok systems associated with the Lorian swamp come 17 specimens of *Barbus oxyrhynchus*. The presence of

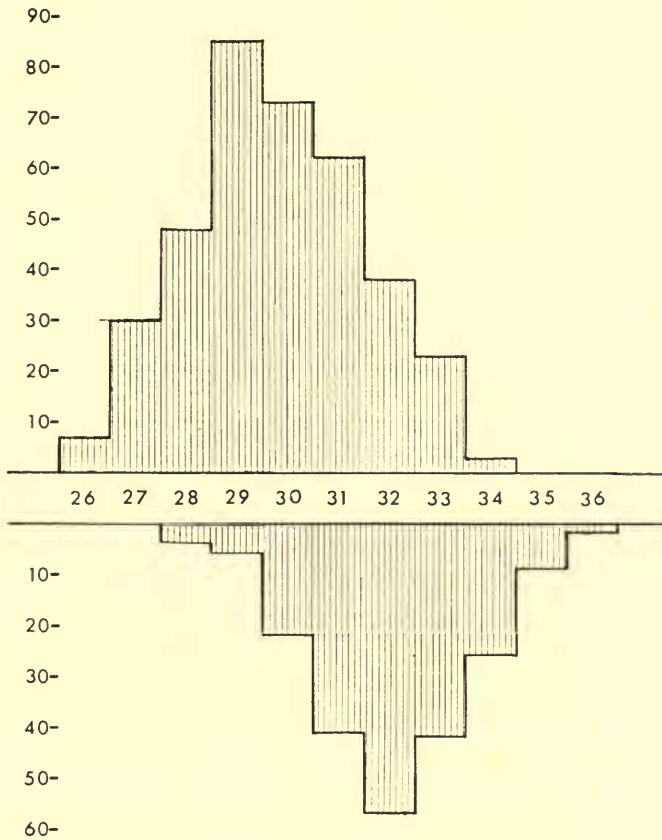


FIG. 60. Histograms comparing the distribution of the lateral line counts of *Barbus intermedius* (above) with *B. altianalis* (below).

'Nilotic' and an 'Athi-Tanan' species in the same river system is surprising, but the watersheds across the divide are low. This area is now semi-desert, but about the time that Lake Baringo was connected to Lake Rudolf the water table must have been much higher and water connections must have linked the two river systems in this region.

The subsequent drop of water level has left the Euasso Nyiro system as a relict area containing examples of the formerly contiguous faunae.

DIAGNOSIS AND AFFINITIES. *Barbus intermedius* is a variable species and bears a close gross morphological resemblance to *Barbus altianalis*, to which I suggest it is very closely related. These two species (and *Barbus acuticeps* and *Barbus ruasae*) form a group of closely related species referred to here as the *intermedius* group or complex.

Typically *Barbus intermedius* has a shallow compressed body, a caudal peduncle longer than it is deep, numerous more or less parallel striae on the scales and a well-ossified dorsal spine of moderate length and stoutness.

It is difficult to distinguish a specimen of *Barbus altianalis* from *Barbus intermedius* if the locality is unknown. There are modal differences in the populations which are listed under *Barbus altianalis*.

Both species are polytypic and can show considerable variation, particularly in body shape and mouth form. However, it has always proved possible to distinguish an unusually deep-bodied member of the *Barbus intermedius* group from a member of the typically deep-bodied *Barbus bynni* group because members of the latter group have more compressed bodies and longer, stronger dorsal spines.

Barbus intermedius is not, as far as I know, found in the same localities as *Barbus altianalis*. The nearest approach of these two species appears to be in the poorly collected Karasuk area to the north-east of Lakes Victoria and Kioga where the headwaters of the Lake Rudolf basin streams and the Lake Victoria and Kioga basin streams are very close.

The *intermedius* complex is discussed further on p. 128. The two subspecies of *Barbus intermedius* can be distinguished, not only by locality, but also by the modally much longer dorsal spine of *Barbus intermedius australis* (\bar{x} = 24.9 against 19.1 in *Barbus intermedius intermedius*). *Barbus intermedius australis* also has a longer pectoral fin (\bar{x} = 23.4 against 21.5) and longer barbels (Ab, \bar{x} = 7.1 against 5.6; Pb, \bar{x} = 8.4 against 6.7). Regrettably it is not always possible to place an individual specimen, lacking locality data, in the correct group.

Barbus intermedius intermedius Rüppell

A general description is given on p. 51. Their orphometric data for this subspecies are :

	n	\bar{x}	s.d.	s.e.	range
D	388	28.1	2.8	0.1	20.7-37.7
H	388	26.5	2.3	0.1	19.0-31.7
I	388	6.0	1.4	0.1	3.5-10.2
IO	388	8.0	0.9	0.04	4.7-11.6
MW	386	5.9	1.0	0.05	3.6- 9.1
Pct	388	21.5	2.0	0.1	15.6-29.0
CPl	388	17.0	1.6	0.1	11.7-22.9
CPd	388	11.5	1.2	0.1	8.6-15.0
Snt	388	8.6	1.2	0.05	5.4-12.7
Ab	385	5.6	1.8	0.1	1.8-11.1
Pb	387	6.7	2.1	0.1	1.9-12.1
DSp	385	19.1	4.2	0.2	6.9-33.9

Not all specimens examined are included in the morphometric data above.

The size range of the specimens is 94 to 489 mm S.L. The lateral line count ranges from 26 to 34; 26 (f.7), 27 (f.27), 28 (f.49), 29 (f.85), 30 (f.85), 31 (f.63), 32 (f.36), 33 (f.25), 34 (f.5).

Between the dorsal mid-line and the lateral line there are 4.5 (f.24), 5 (f.1), 5.5 (f.325), 6 (f.2) or 6.5 (f.32) scale rows. Between the lateral line and the

ventral mid-line there are 4 (f.1), 4.5 (f.109), 5 (f.2), 5.5 (f.226), 6 (f.1), 6.5 (f.29) or 7.5 (f.1) scale rows. Between the lateral line and the base of the ventral fin there are 1.5 (f.2), 2 (f.9), 2.5 (f.242), 3 (f.40), 3.5 (f.85), 4 (f.1) or 4.5 (f.3) scale rows.

DISTRIBUTION. The distribution is as on p. 70 except for Lake Baringo.

***Barbus intermedius australis* ssp. nov.**

HOLOTYPE. A fish of 128 mm S.L., No. 18 in 1932.6.13:191-200, from a jar labelled *Barbus gregorii*, Lake Baringo, in the collection of the B.M. (N.H.). This specimen was selected as being close to the mean for most morphometric characters, and therefore is typical of the population.

DESCRIPTION. The description is largely as for the nominate subspecies (see p. 51). The morphometric data in detail are as follows and based on 58 specimens, S.L. 66-388 mm.

	n	\bar{x}	s.d.	s.e.	range
L					66 - 388 mm
D	58	30.0	2.2	0.3	26.3-35.1
H	58	26.2	1.7	0.2	23.0-31.0
I	58	6.0	1.0	0.1	4.4- 9.1
IO	58	8.1	1.0	0.1	6.1-12.3
MW	58	5.5	0.7	0.1	4.1- 7.3
Pct	58	23.4	1.5	0.2	21.0-27.2
CPI	58	16.1	1.4	0.2	11.7-18.7
CPd	58	12.7	0.9	0.1	9.5-14.2
Snt	58	8.4	0.9	0.1	6.7-10.7
Ab	58	7.1	1.2	0.2	4.8-10.0
Pb	58	8.4	1.3	0.2	6.0-10.9
DSp	58	24.9	3.9	0.5	15.6-32.3

The number of scales in the lateral line ranges from 27 to 33: 27 (f.4), 28 (f.11), 29 (f.18), 30 (f.9), 31 (f.8), 32 (f.6), 33 (f.2). Only one specimen has 6.5 scale rows between the dorsal mid-line and the lateral line, the rest have 5.5. Between the lateral line and the ventral mid-line there are 4.5 (f.51), 5.5 (f.4), or 6.5 (f.1) scale rows. Between the lateral line and the base of the pelvic fin there are 2.5 (f.4), 3 (f.1), or 3.5 (f.52) scale rows.

The distinguishing characters of the two subspecies are the longer dorsal spine, longer pectoral fins, slightly deeper body and longer barbels in *Barbus intermedius australis*.

Lake Baringo is an alkaline lake, and it is impossible to say whether the Baringo population displays its particular phenotype as a result of the environment or as a result of the genotype. There are very slight indications that the fishes from the Omo river and Lake Rudolf incline slightly towards the Baringo facies but it must be remembered that the Lake Rudolf and Omo river sample is extremely small.

DISTRIBUTION. This species is known from Lake Baringo, Kenya.

Barbus longifilis Pellegrin 1935

Barbus altianalis var. *longifilis* Pellegrin, 1935, *Revue Zool. Bot. afr.* **27** (3) : 376-385 (part, not the specimen from Nyabarongo).

NOTES ON THE DETERMINATION. This species, from the upper reaches of the Luhoho Congo, is not a variety of *Barbus altianalis*, but a well-defined species. One of Pellegrin's type series (M.H.N.P. No. 35-75) is better referred to *Barbus paucisquamatus*. Poll (1939:69) synonymized *Barbus altianalis* var. *longifilis* with *Barbus altianalis* var. *paucisquamata*, a move which does not take into account the much longer dorsal spine, the much longer barbels and the much deeper body of the former variety.

LECTOTYPE. A fish of 173 mm S.L. (M.H.N.P. No. 35-150). This is the least-damaged specimen of Pellegrin's type series from the Loama river.

DESCRIPTION. The description is based on nine specimens, 132-247 mm S.L.

	\bar{x}	s.d.	s.e.	range
D	31.2	1.6	0.5	29.2-34.0
H	24.6	0.7	0.2	23.5-25.3
I	6.5	0.5	0.1	6.0- 7.2
IO	8.0	0.5	0.2	7.0- 8.6
MW	5.5	0.6	0.2	4.5- 6.3
Pct	23.1	1.0	0.3	21.7-24.2
CPI	17.0	1.0	0.3	15.8-18.3
CPd	11.4	0.7	0.2	9.9-12.1
Snt	8.3	0.6	0.2	7.5- 9.3
Ab	8.9	0.7	0.2	8.3- 9.6
Pb	11.3	1.1	0.4	9.5-13.4

Barbus longifilis has a pointed snout. Except for a slight nuchal hump the dorsal profile is straight from the snout to the origin of the dorsal fin. The mouth is ventral with thin fleshy lips; the barbels are characteristically long.

Dorsal fin. Has IV-9 (f.8) or IV-10 (f.1) rays, the last unbranched ray is solidly ossified into a thick straight spine (\bar{x} = 25.6, s.d. = 2.7, s.e. = 1.0, range 22.0-30.3). The dorsal fin origin is usually in front of the insertion of the pelvic fins. A large sheath of large scales surrounds the base of the dorsal fin.

The *anal fin* has three unbranched and five branched rays.

Squamation. The striae on the scales are slightly irregular, either parallel or slightly converging, the lateral line has 25 (f.1), 26 (f.3), 27 (f.3) or 28 (f.2) scales. There are 4.5 scales between the dorsal mid-line and the lateral line and 5.5 between the lateral line and the ventral mid-line. There are 2.5 (f.7) or 3 (f.2) scale rows between the lateral line and the base of the pelvic fins and without exception 12 scales are present around the caudal peduncle.

There are between 10 and 12 *gill rakers* on the lower arm of the first gill arch in the specimens examined.

Pharyngeal bones and teeth. The pharyngeal tooth formula is 2.3.5.-5.3.2. The first tooth in the inner row (fig. 62) is conical and directed posteriorly, the second

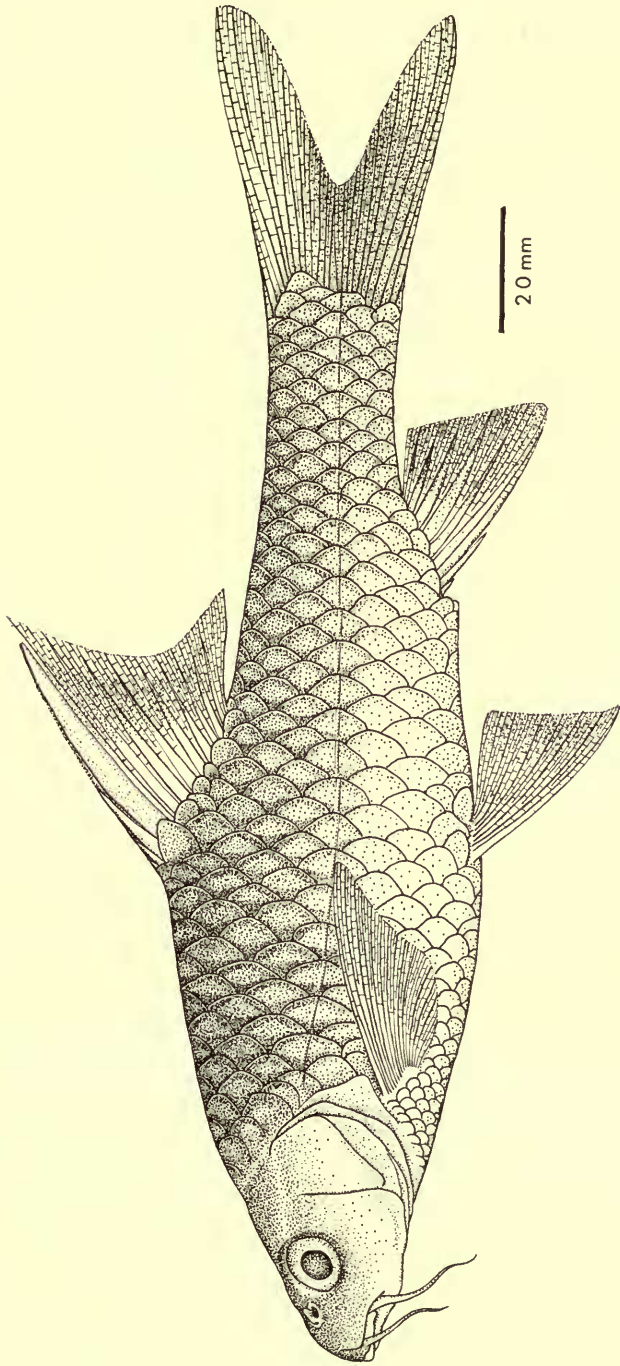


FIG. 61. *Barbus longifilis* lectotype.

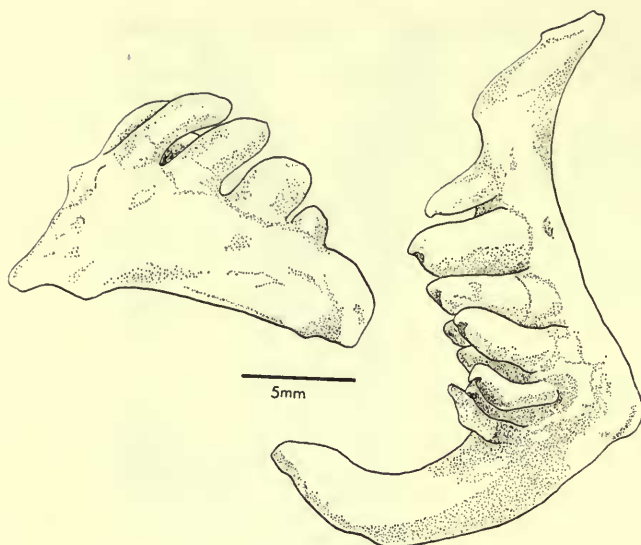


FIG. 62. The left pharyngeal bone from the lectotype of *Barbus longifilis*.

tooth is taller and more flattened laterally than the first. A small concavity on the posterior face of the crown creates a slight hook, the hook and the concavity progressively enlarge on teeth 3, 4 and 5. The teeth of the second and third rows are small, less extreme versions of the posterior tooth on the inner row.

Coloration. The body of preserved specimens is brassy, slightly darker on the back than on the belly. A band of dark-brown pigment is present on the middle third of the fin membrane of the dorsal and pelvic fins and extends from the middle to the end of the pectoral, anal and caudal fins, the density of the pigment varies considerably from specimen to specimen, especially the caudal fin.

DISTRIBUTION. The specimens examined came from the Loama and Kanséhété rivers, Congo.

DIAGNOSIS AND AFFINITIES. *Barbus longifilis* is a member of the *Barbus bynni* group (see p. 36). The much longer barbels distinguish this species from *Barbus bynni* and *Barbus gananensis*. In other respects it most closely resembles *Barbus oxyrhynchus* and were the two species found in the same area it may be difficult to assign some individual specimens (especially preserved material) to either of the two species. The longer barbels and more heavily pigmented fins in *Barbus longifilis* will usually enable it to be distinguished from *Barbus oxyrhynchus* where locality data are unavailable.

Cooke (1958 : 26) presents some evidence to suggest that some Athi-Tana faunal elements had been able to move across the Lake Victoria area. He cites the presence of the Athi river species *Tilapia nigra* which occurs in the mid-Pleistocene beds at Rawi in the Kavirondo Gulf. The relationship of Lake Victoria to the headwaters of the Congo in Pleistocene times is discussed on page 22. There is just a possibility

that there could have been a movement of *Barbus oxyrhynchus* (or its ancestor) from the Athi into the Congo before the rift valley broke the connection (see fig. 4 in Cooke, *op. cit.*) and that *Barbus longifilis* represents a surviving population descended from this migration.

***Barbus macrolepis* Pfeffer 1889**

Barbus macrolepis Pfeffer, 1889, *Jb. hamb. wiss. Anst.* 6 (2) : 17; Pfeffer, 1893, *Jb. hamb. wiss. Anst.* 10 (2) : 34, pl. 1, fig. 1; Pfeffer, 1896, *Thierw. O-Afr. Fische* : 63.

LECTOTYPE. The lectotype was selected by Ladiges *et alii* (1958) as a fish of 108 mm S.L. (this specimen was kindly measured for me by Dr W. Ladiges), Reg. No. H.330 from Mbusini on the Wami River, Tanzania.

DESCRIPTION. The description is based on 20 fishes, from 48 to 243 mm S.L.

	\bar{x}	s.d.	s.e.	range
L				48 - 243 mm
D	33.1	3.5	0.8	29.9-38.2
H	27.6	2.3	0.5	24.4-31.3
I	7.6	1.4	0.3	4.6-10.1
IO	8.9	0.9	0.2	7.3-10.4
MW	6.8	0.8	0.2	5.3- 8.3
Pct	21.7	1.6	0.4	18.5-24.6
CPl	14.6	1.9	0.4	11.4-20.3
CPd	14.8	1.4	0.3	12.9-17.2
Snt	7.9	1.7	0.4	5.8- 9.0
Ab	3.5	1.3	0.3	1.6- 6.3
Pb	5.8	2.5	0.6	1.4- 9.0

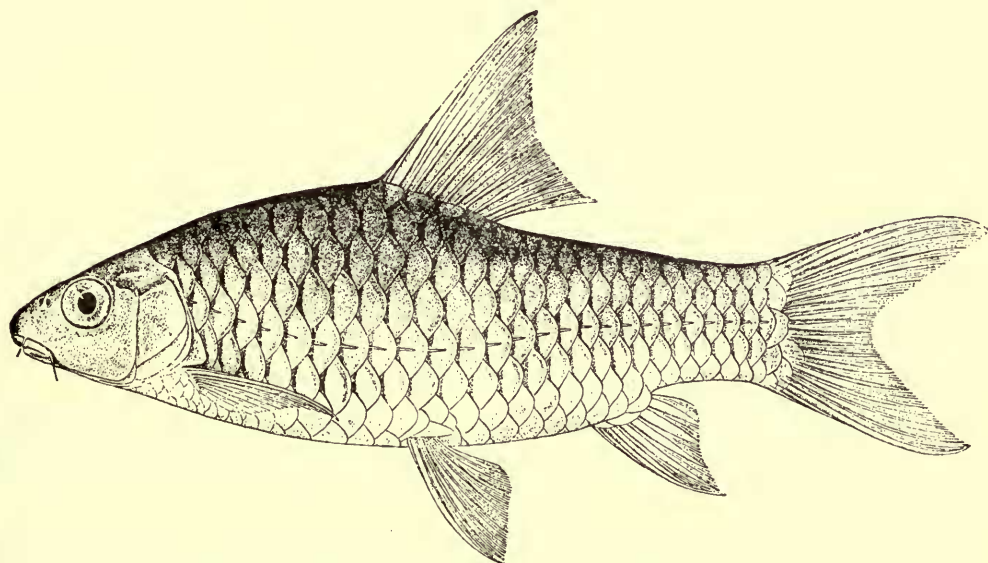


FIG. 63. *Barbus macrolepis* (from Boulenger 1911a).

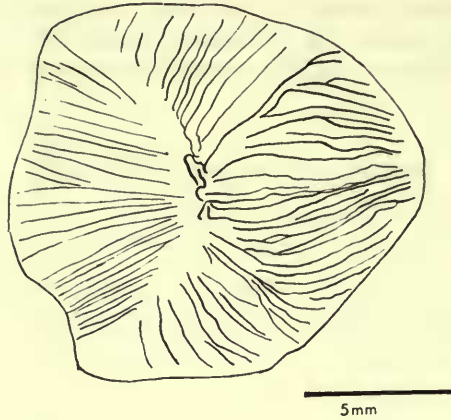


FIG. 64. A scale from the shoulder of *B. macrolepis* to show the position of the striae.

The three paralectotypes examined have the overall body shape of the figured example. The larger fish have a straighter ventral profile and a more humped back. The mouth is sub-terminal or just ventral, horse-shoe shaped; in all the specimens the lips are slightly thickened and fleshy.

Of four specimens radiographed, three had 36 vertebrae and one had 37.

Dorsal fin. Has four unbranched rays and 9 (f.7) or 10 (f.13) branched rays. The last unbranched ray is weakly ossified with persistent articulations distally. The length of the non-articulated part ranges from 8.7 to 20.8 per cent S.L. with a mean value of 15.3. The whole ray though, when unbroken, is 35 per cent of the S.L. which gives a high dorsal fin, with a markedly concave dorsal margin. This ray is more elongated in larger fish. The syntypes have a very small sheath of scales at the base of the dorsal fin. This sheath is not present in the larger fish; as there is no sign of physical damage it presumably has been lost as a result of growth. The leading edge of the dorsal fin is slightly in advance of the pelvic fin.

The *anal fin* has three unbranched rays and five branched rays. The last ray of the latter is in some cases markedly bifurcated.

Squamation. There are 22 (f.7), 23 (f.5), 24 (f.4) or 25 (f.1) scales in the lateral line; 3.5 (f.6) or 4.5 (f.12) scales between the dorsal mid-line and the lateral line and 3 (f.1), 3.5 (f.7) or 4.5 (f.1) scales between the lateral and the ventral mid-line. On several specimens the scales could not be counted reliably. One and a half (f.4) or 2.5 (f.16) scale rows are present between the lateral line and the insertion of the pelvic fin. There are 12 scales around the caudal peduncle.

The striae on the scales are characteristic (fig. 64). They are comparatively sparse on the exposed portion of the scale and converge towards the posterior edge of the scale. In this respect they contrast significantly with those of *Barbus oxyrhynchus* (fig. 81).

Pharyngeal bones and teeth (figs. 65 and 66). The first tooth of the inner row is small, conical with a small spoon-shaped depression at the crown. The second

tooth is much thicker and higher with a hooked crown. The teeth become progressively thinner posteriorly and the hook and the depression become more exaggerated. The pharyngeal tooth formula is 2.3.5.-5.3.2.

Gill rakers. There are 12-14 broad, hooked gill rakers on the ventral limb of the first gill arch.

Coloration. Preserved specimens are light brown on the back and a paler silvery-brown on the lower part of the flanks. The scales are dark edged. The caudal and dorsal fins are brownish, the other fins are hyaline.

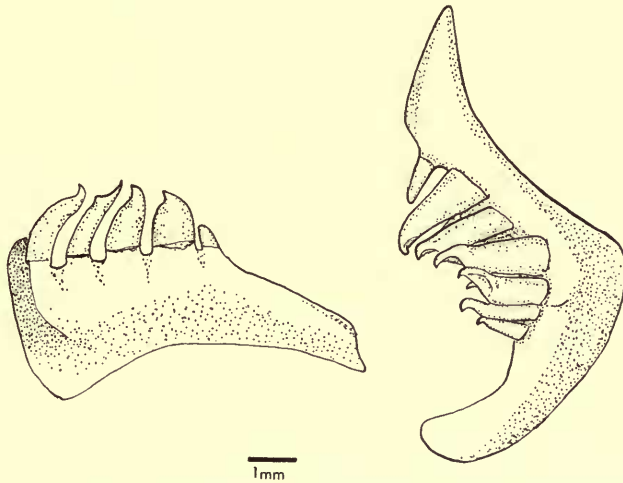


FIG. 65. The left pharyngeal bone from a specimen of *B. macrolepis* of 94 mm S.L.

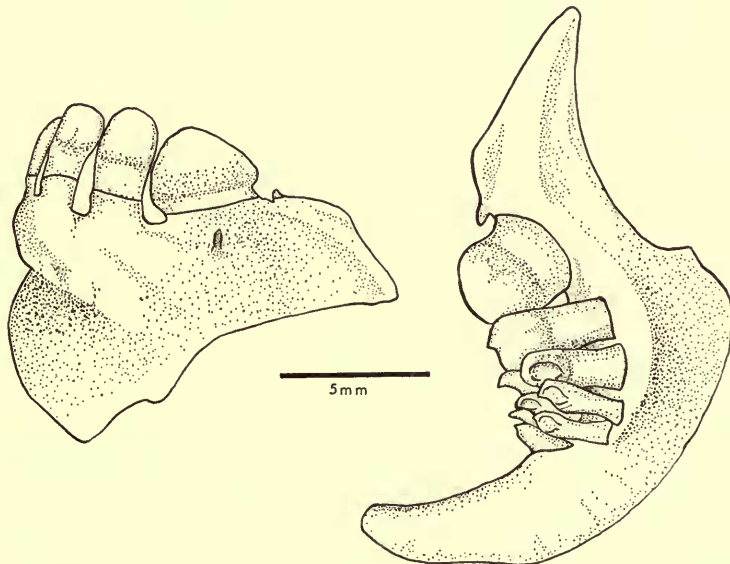


FIG. 66. The left pharyngeal bone from a specimen of *B. macrolepis* of 243 mm S.L.

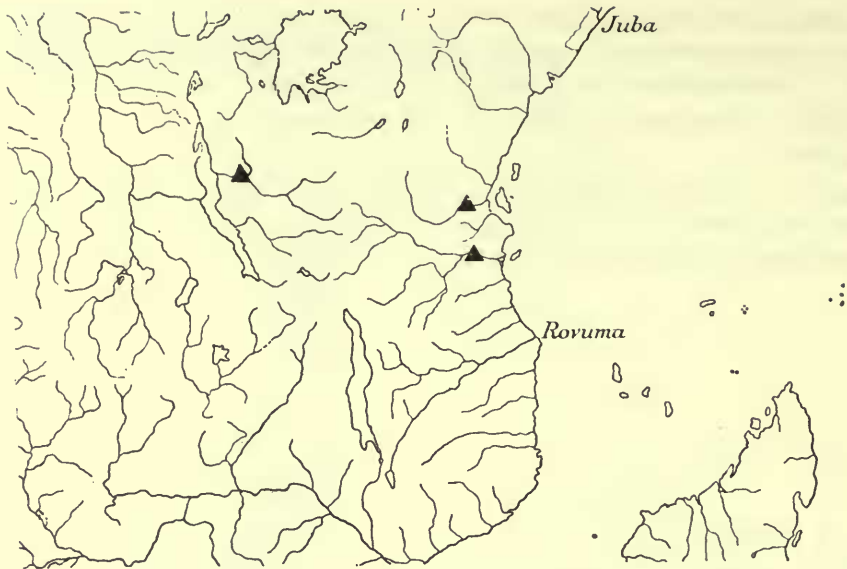


FIG. 67. A map of the distribution of *Barbus macrolepis*.

DISTRIBUTION. This species is known from Katare (or Kotare), Malagarasi swamp; from the Wami, Ruaha and Rufiji rivers, Tanzania.

The distribution of this species is rather unusual in that it is confined to a narrow belt between 5 and 8 degrees South but covers a wide longitudinal range from Malagarasi to near the Tanzanian coast. The Malagarasi river drains westwards into Lake Tanganyika whilst the other two rivers flow eastward into the Indian Ocean.

The Malagarasi has certain Congo faunal affinities and its geological history suggests that it was once part of the Congo system. The eastward flowing rivers do not have any Congo links.

DIAGNOSIS AND AFFINITIES. *Barbus macrolepis* is a distinctive species. The body is deep, the last simple dorsal fin ray is tall and weak, the caudal peduncle is nearly as deep as it is long and the striae on the scales converge markedly. The striae on the scales of *Barbus marequensis* are parallel, but the tall crescentic dorsal fin of the larger specimens is also present in specimens of *Barbus marequensis* from the Zambezi river to the south of the Rufiji river.

The more heavily ossified last simple ray of the dorsal fin of *Barbus oxyrhynchus* in the rivers to the north of the Wami and the parallel sinuous striae on the scales are easily distinguished points of difference from *Barbus macrolepis*.

Poll (1967 : 181) is of the opinion that *Barbus jubbi* has some marked similarities to *Barbus macrolepis*, principally in the high number of dorsal fin rays and the low number of scales in the lateral line series. However, the striae on the scales are quite different, as is the dorsal fin spine and at the moment I am inclined to think that the resemblances are spurious.

A very much greater degree of morphological similarity exists between *Barbus macrolepis* and *Barbus lagensis* from Nigeria. Both species have ten unbranched rays in the dorsal fin; a high but weak fourth unbranched ray in the dorsal fin; a comparable low number of scales in the lateral line series and very similar striations on the scales.

I have not seen sufficient *Barbus lagensis* material to comment further on the relationships of these two species but both seem very different from the other African *Barbus* species and if the characters in common are not the result of convergence, then the real possibility exists that these two species are related and if so then their distribution may indicate that they are relicts of an early invasion of *Barbus* species (see p. 132). I have not seen any other African *Barbus* species that have converging striae on their scales and the combination of a deep body, large scales and a high dorsal fin without a well-ossified dorsal spine is also unique. Some of these characters are found in some Asian *Barbus* species, e.g. converging striae are found in *Barbus longispinis* Günther, this Celanese species has striae which converge more with age but it has a strong dorsal spine. *Barbus macropus* Blkr. and *Barbus huguenini* Blkr. respectively from Borneo and Sumatra are deep-bodied fishes with large scales and few converging striae; however, they have a serrated dorsal spine. I have not been able to find any mainland Asiatic species which have all the characters under discussion, but it seems that the presence of converging striae is more frequent in Asiatic *Barbus* species than it is in African *Barbus* species. I have not been able to examine as many Indian species as I would have liked but the occurrence of the converging striae in some of the Asiatic island species suggests that it may be a primitive feature (or at least an ancient one) which is present in two African species. At the moment I cannot with any certainty align *Barbus macrolepis* with any Asiatic species because it is impossible to show that the similarities in the pattern of scale striae are not due to convergence. If it is not due to convergence, then it is possible that there may be some fairly close relationship between a group of Asiatic *Barbus* species and a pair of African species. This idea, though, assumes that the differences in the dorsal spines are of less significance than the similarities in the scale striations and sadly this is a matter on which I have no information at all.

Barbus mariae Holly 1929

Barbus mariae Holly, 1929, *Anz. Akad. Wiss. Wien* **66** (4): 34; Copley, H., 1958, *Common Freshwater Fishes of E. Africa*: 78-80.

Barbus rhinoceros Copley, 1938, *Jl. E. Africa Uganda nat. Hist. Soc.*, **13**: 191.

NOTES ON THE SYNONYMY. It may well eventually prove necessary to synonymize *Barbus mariae* with *Barbus matris*, Holly, 1928 [*Zool. Anz. Leipzig* **85** (1-2)] from the Athi river at Nairobi. Holly's description of *Barbus matris* is very similar to that of *Barbus mariae* but I am unwilling to proceed in this matter without examining the holotype of *Barbus matris* and at the time of writing this has not been located.

LECTOTYPE. Holly described this species on the basis of two specimens of 280 mm and 295 mm total length from the Kitui river (Athi system) in Kenya. I

have not seen either of these specimens which are supposed to be in the Natural History Museum, Vienna, but they could not be located by Dr P. Kahsbauer who kindly searched for them. The larger specimen is designated the lectotype on the assumption that both specimens are extant.

DESCRIPTION. The description is based on five specimens in the B.M. (N.H.) collections of standard lengths, 86, 105, 112, 117 and 342 mm from the Athi river.

	\bar{x}	range
D	26.9	24.4-29.5
H	30.7	30.1-32.5
I	8.5	5.5-10.4
IO	6.8	5.8- 8.5
MW	5.2	4.5- 7.0
Pct	22.5	21.9-22.5
CPl	17.3	16.1-19.6
CPd	10.6	9.3-12.9
Snt	9.9	8.9-10.4
Ab	2.7	1.2- 3.8
Pb	5.3	4.5- 5.8

All measurements are expressed as percentages of the standard length. With this particular sample it was not considered useful to calculate the standard deviation and the standard error.

Barbus mariae is a distinctive species. The upper jaw has a remarkable median protrusion (the 'rhinoceros horn' of Copley 1958) when the mouth is open. This is caused by the fish having a large kinethmoid (*sensu* Alexander 1966). The antero-ventral edge of the labial part of the premaxilla is gently curved and overhangs the lower jaw giving a 'clupeoid' appearance to the jaws.

The body is long and thin, the dorsal fin has its origin in the posterior half of the body more or less vertically above the insertion of the pelvic fin.

Dorsal fin. It has IV-9 rays. The fourth unbranched ray is heavily ossified, smooth and from 17.5 to 32.6, \bar{x} = 29.0, of standard length (negatively allometric). The dorsal margin of the fin is markedly concave.

Anal fin. With III-5 rays.

Squamation. Holly gives 30 or 31 for the lateral line scale count of the specimens he described. The specimens I examined have 27 (f.1), 28 (f.1), or 29 (f.3) scales. The difference is probably attributable to the different techniques used in counting these scales. The figures given by Holly agree with the complete number of scales in the lateral line series if 27 or 28 are present to the end of the hypurals. There are 12 scales around the caudal peduncle, 4.5-5.5 between the dorsal mid-line and the lateral line and 4.5 between the lateral line and the ventral mid-line. One and a half or 2 scales were present between the lateral line and the base of the pelvic fin.

Pharyngeal bones and teeth. The pharyngeal tooth formula is 2.3.5.-5.3.2. The first tooth in the inner row is about two-thirds of the length of the second. The second tooth is the widest. All in this row are unicuspid and recurved and the

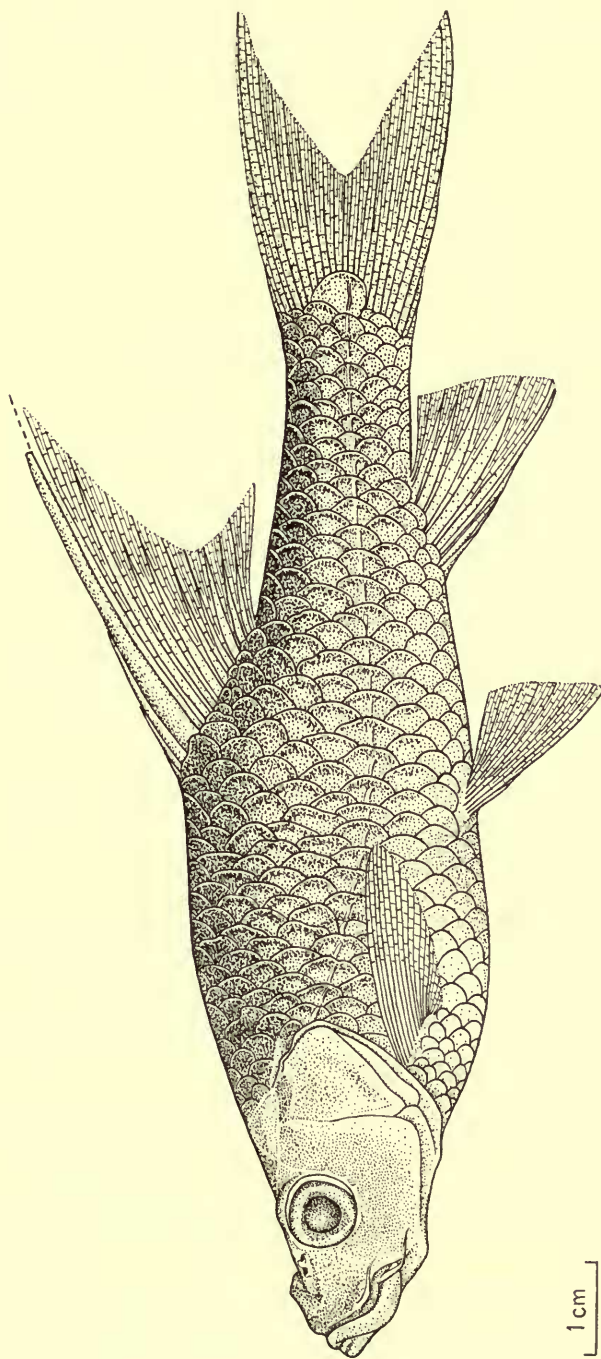


FIG. 68. *Barbus mariae*: a B.M. (N.H.) of 117 mm S.L.

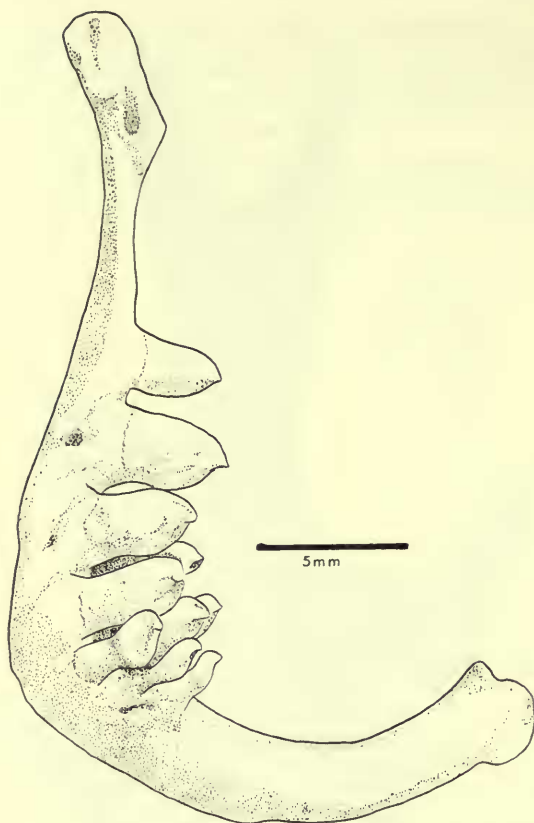


FIG. 69. The left pharyngeal bone from a specimen of *Barbus mariae* of 342 mm S.L.

teeth become more hooked, taller and thinner posteriorly. Only the pharyngeal teeth of the largest specimen were examined.

Gill rakers. On the largest specimen $9 + 1$. The gill rakers were widely spaced and hooked forward. This number is lower than is usual among the large *Barbus* species under consideration in this revision.

Coloration. Holly's (*op. cit.*) remarks on the coloration match the colour of the preserved specimens I examined. The back is dark ochre-brown shading to a silvery-yellow in the belly. The fins are very light brown and the scales have dark edges. Copley (1958) states that the live fish are olive-brown on the back and silvery on the belly.

DISTRIBUTION. The five specimens 1936.12.22 : 35-39 in the B.M. (N.H.) collections are from the Athi river. Specimen No. B.M. (N.H.) 1937.6.4 : 16 has only the locality Kenya. Copley (1958) records it from the Athi and Tana systems, he also mentions that they can weigh up to 48 lb.

DIAGNOSIS AND AFFINITIES. *Barbus mariae* is most easily distinguished by the 'rhinoceros horn'-like development of the kinethmoid and the 'clupeoid' appearance of the upper jaw. *Barbus mariae* is sympatric with *Barbus oxyrhynchus* but lacks many of its characters and I am unable, at the moment, to comment further on its relationships.

***Barbus microbarbis* David and Poll 1937**

Barbus microbarbis David & Poll, 1937, *Annls. Mus. r. Congo Belge Zool.* (1) 3 (5) : 261 (only the holotype).

HOLOTYPE. A fish of 216 mm S.L. from Lake Luhondo, Rwanda; M.A.C.T. No. 41847. The two paratypes (M.A.C.T. Nos. 41848, 41849) do not belong to this species, nor do any of the other specimens in the M.A.C.T. collection (Nos. 56449-56455, 56479, 92966-92968, 94219-94220). This species is split because the holotype has a sub-terminal mouth, five teeth in the inner pharyngeal row, a smoothly curved pharyngeal bone outline, nine branched rays in the dorsal fin and 15 gill rakers on the lower limb of the first gill arch (in contrast to the ventral mouth, horny covered lower jaw, four teeth on the inner pharyngeal row, an oddly shaped pharyngeal bone, 10 branched dorsal fin rays and 19-20 gill rakers on the lower limb of the first gill arch of the paratypes and the other M.A.C.T. specimens). All the specimens previously included in this species are now considered to belong to *Varicorhinus ruandae* Pappenheim, & Boulenger, 1914.

DESCRIPTION. The description is based on the holotype. $D = 31.0$; $H = 23.6$; $I = 5.6$; $IO = 9.2$; $MW = 7.4$; $Pct = 19.9$; $CPI = 15.7$; $CPd = 11.1$; $Snt = 3.3$. The mouth is sub-terminal, the lower jaw is curved without a horny margin and both anterior and posterior barbels are present although very short. Scales on the posterior part of the body have parallel striae but are radiately striated on the shoulders; 32 scales in the lateral line, 12 around the caudal peduncle, 5.5 between the dorsal mid-line and the lateral line; 5.5 between the lateral line and the ventral mid-line and 2.5 between the lateral line and the base of the pelvic fin.

The dorsal fin has four unbranched rays, the last is moderately thickened and ossified into a smooth spine, the non-articulated part of which is 11.0 per cent of the standard length. There are nine branched rays and the dorsal margin of the fin is slightly concave.

The *anal fin* has three unbranched and five branched rays. David & Poll (1937) give six branched rays but they were apparently misled by the complete bifurcation of the last ray.

Pharyngeal bones and teeth. The right pharyngeal bone is shown in fig. 71; the fifth tooth in the inner row is notable for the presence of a ridge across the concave crown. All the teeth are hooked.

There are 16 short, broad *gill rakers* on the lower limb of the first gill arch.

Coloration. Described by David & Poll (*op. cit.*) as dark grey on the back, lighter grey below. Scales with a black border. The colour now is dark brown on the back and lighter brown below.

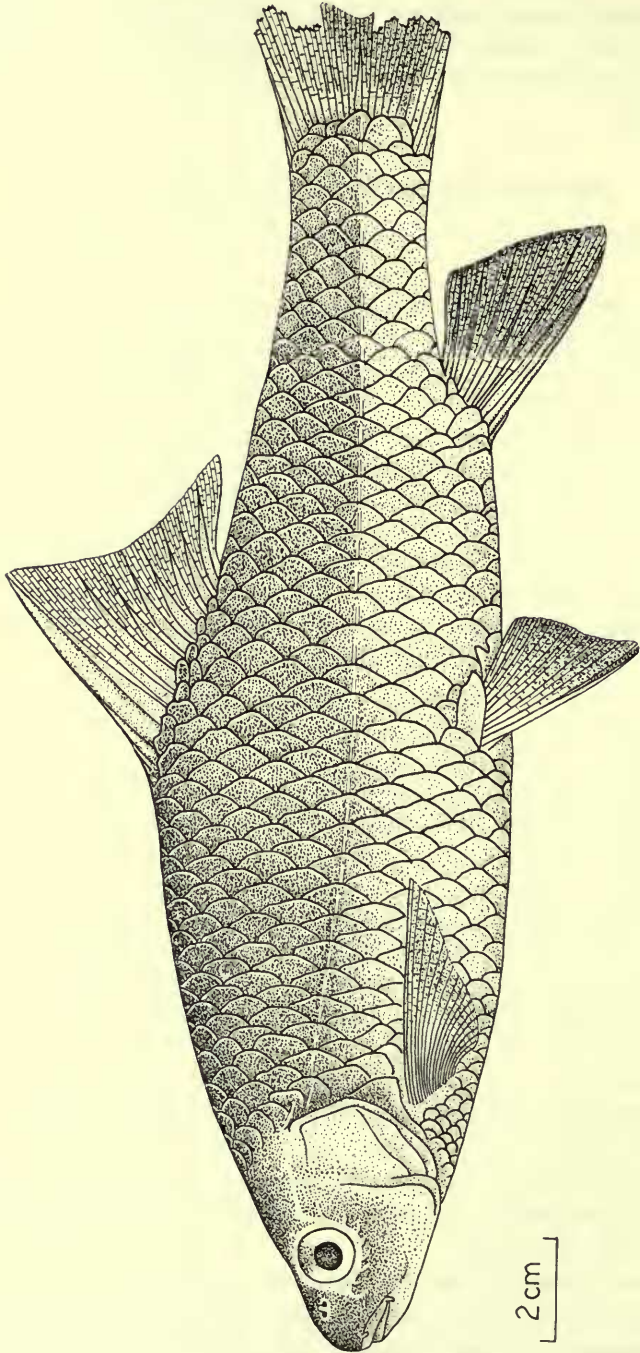


FIG. 70. *Barbus microbarbis* holotype.

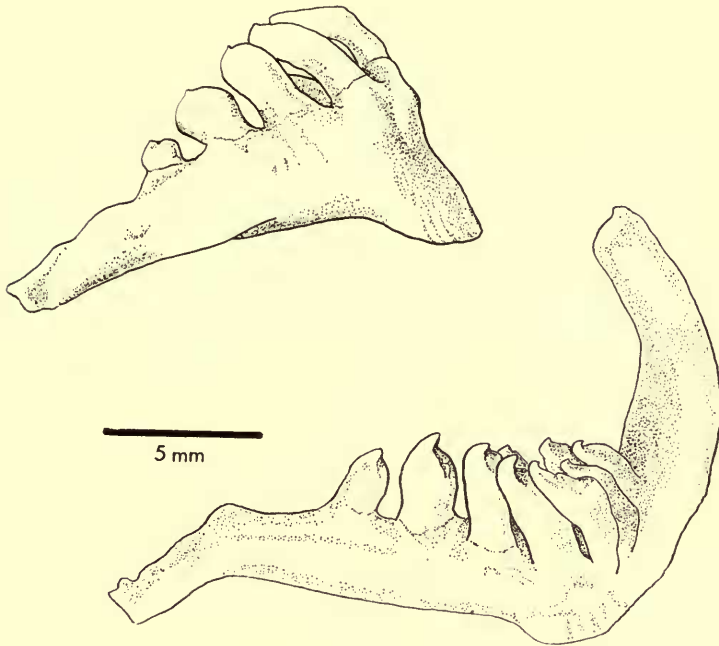


FIG. 71. The right pharyngeal bone from the holotype of *Barbus microbarbis*.

DISTRIBUTION. This species is known only from Lake Luhondo, Rwanda.

DIAGNOSIS AND AFFINITIES. *Barbus microbarbis* is characterized by having very short barbels and a wide sub-terminal mouth with a gently curving lower jaw. In these two characters this species approaches members of the ill-defined genus *Varicorhinus* Rüppell but is clearly separate from *Varicorhinus ruandae* (see above) with which it is sympatric.

It is unwise to speculate too much on the basis of one specimen. *Barbus microbarbis* could be an abnormal specimen of *Barbus altianalis* or *Barbus acuticeps*. Groenewald (1958) has shown how the mouth shape can change markedly. This individual could be a hybrid between a *Barbus* species and a *Varicorhinus* species.

Without more specimens and a greater knowledge of the fauna of the area the relationships and nature of this species must be left in abeyance.

***Barbus microterolepis* Boulenger 1902**

Barbus microterolepis Blgr., 1902, *Ann. Mag. nat. Hist.* (7) 10 : 426; Blgr., 1911, *Cat. Afr. Fish* 2 : 23, fig. 5.

HOLOTYPE. A fish of 118 mm S.L. from the Maki river, Lake Zwai, Ethiopia, B.M. (N.H.) Reg. No. 1902.12.13 : 220.

DESCRIPTION. The description is based on the only known specimen of this species. All measurements are expressed as percentages of the standard length.

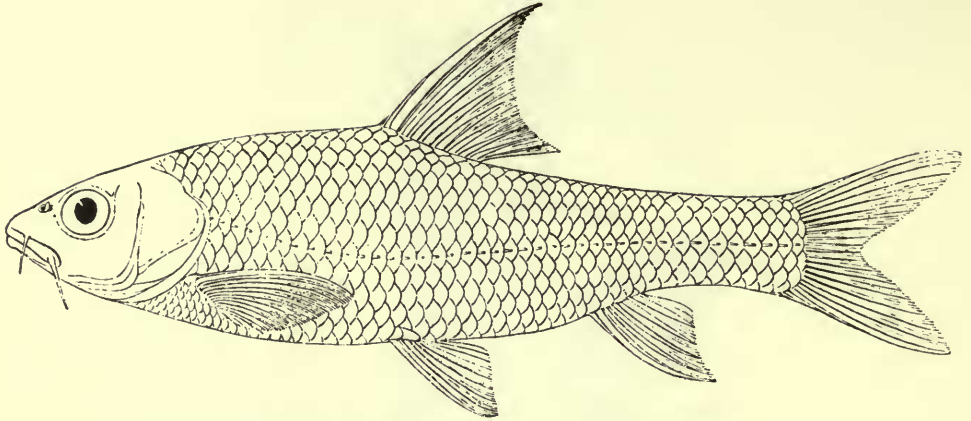


FIG. 72. *Barbus microterolepis* holotype (from Boulenger 1911a).

D = 27.1 ; H = 25.4 ; I = 7.6 ; IO = 7.6 ; MW = 5.9 ; Snt = 7.6 ; Pct = 21.2 ; CPI = 16.9 ; CPd = 10.2 ; Ab = 5.1 ; Pb = 6.8.

The shape of the body can be seen in fig. 72.

Squamation. The lateral line has 40 scales. There are 7.5 scale rows between the dorsal mid-line and the lateral line and 6.5 scale rows between the lateral line and the ventral mid-line. There are four scales between the lateral line and the base of the pelvic fin. Around the caudal peduncle there are 15 or 16 scales. The scales bear numerous fine parallel striae.

Dorsal fin. The dorsal fin origin is slightly in front of the pelvic fin insertion. It has four unbranched rays, the last of which is ossified into a smooth spine of length 22.9 per cent. There are eight branched rays the last of which is bifid.

The *anal fin* has five branched rays and three unbranched rays.

Pharyngeal bones and teeth. The first tooth in the inner row (fig. 73) is small and conical, the second tooth is longer and thicker with a recurved, unicuspid crown. The other three teeth in this row become progressively thinner and more hooked. There are no molariform teeth. The pharyngeal tooth formula is 2.3.5.-5.3.2.

Gill rakers. Ten moderately stout, slightly curved gill rakers are present on the lower limb of the first gill arch. Three gill rakers are present on the upper limb.

Coloration. Boulenger (*op. cit.*) describes the colour of the preserved specimen as olive above, silvery beneath.

DISTRIBUTION. This species is known only from the Maki river, which is a fast-flowing stream rising in the hills of Gouaza and emptying into Lake Zwai.

AFFINITIES. Any conclusions about this species, based on one specimen, must be regarded as tentative. The Zwai basin contains two other endemic cyprinids, *Barbus ethiopicus* and *Garra makiensis* (Blgr. 1911a ; Menon 1964). The geology of the area is not known in enough detail to be able to decide whether the endemism

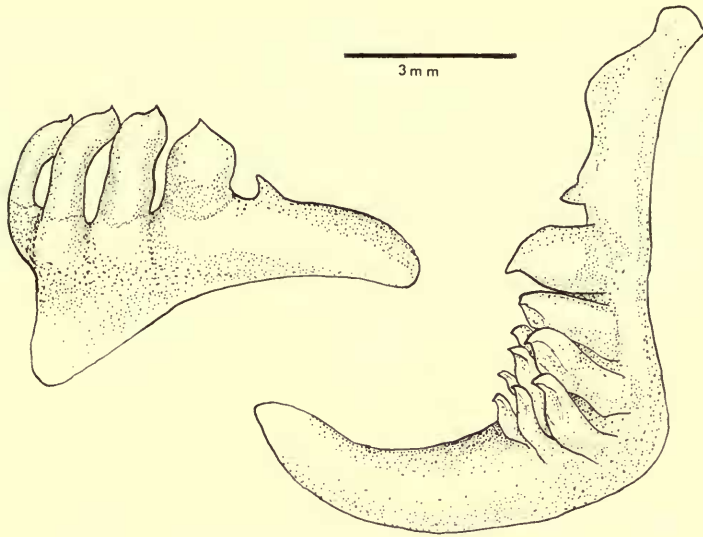


FIG. 73. The left pharyngeal bone from the holotype of *Barbus microterolepis*.

is the result of a long isolation or not. There are several possibilities concerning *Barbus microterolepis*. It could be an abnormal specimen of *Barbus intermedius* in which the number of scales has been increased by a chance mutation. *Barbus intermedius* lives in the Zwai basin and differs from *Barbus microterolepis* in the size of the scales. *Barbus microterolepis* could be a valid species descended from a common ancestry with *Barbus intermedius* having an increase in scale numbers. If this is so one must conclude that the species must be rare or inhabiting inaccessible regions as only one fish has ever been collected. A third possibility is that *Barbus microterolepis* is a hybrid between the small-scaled *Barbus ethiopicus* of Lake Zwai and *Barbus intermedius*. There is no evidence at the moment that *Barbus microterolepis* is not a valid species but more specimens are needed before any firm conclusions regarding its affinities can be reached.

Barbus mirabilis Pappenheim and Boulenger 1914

Barbus mirabilis Pappenheim & Blgr., 1914, *Wiss. Ergebn. dt. ZentAfr. Exped. Zool.* (3) 5: 239.

HOLOTYPE. A fish of 353 mm S.L., Z.M.B. Reg. No. 19059.

DESCRIPTION. The description is based on the holotype as I have not been able to find any other specimens which have been referred to this species. D = 30.8; H = 24.6; I = 4.2; IO = 10.0; MW = 7.1; Pct = 19.8; CPI = 13.8; CPd = 11.9; Snt = 8.5; Ab = 4.7; Pb = 5.4. All these measurements are expressed as percentages of the standard length.

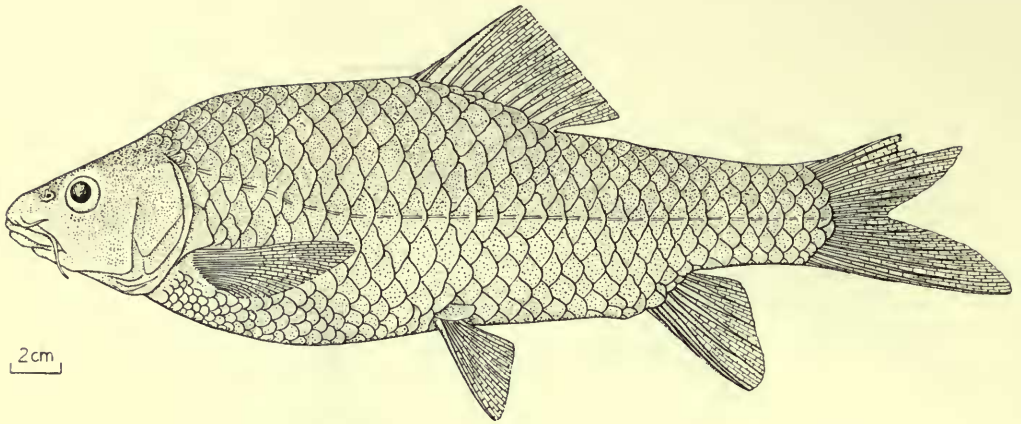


FIG. 74. *Barbus mirabilis* holotype.

The shape of the body can be seen in fig. 74 and it presents a rather bulky appearance.

Squamation. The striae on the scales are slightly diverging, less so on the shoulder scales than on the flanks or belly. There are 28 scales in the lateral line (Pappenheim and Boulenger's count of 31 is the total number). Five and a half scale rows are between the dorsal mid-line and the lateral line and the same number between the lateral line and the ventral mid-line. Three scale rows lie between the lateral line and the base of the pelvic fin. The scales on the chest are reduced in size and are less well formed. There are 12 scales around the caudal peduncle.

The mouth is sub-terminal and crescentic with a continuous lower lip.

Dorsal fin. Has four unbranched rays. The last ray is ossified into a smooth spine, the non-articulated part of which is 9.6 per cent of the standard length. There are ten branched rays. The origin of the dorsal fin is in front of the pelvic fins. There is no sheath of scales at the base.

Coloration. The preserved fish is pale brown in colour with a darker lower lobe of the caudal and a dark edge to the pectoral fins. The back and sides above the lateral line are slightly darker than the belly.

Gill rakers. There are 10 gill rakers on the lower arm of the first gill arch.

Pharyngeal bones and teeth. The pharyngeal teeth (figs. 75 and 76) have slightly hooked crowns. There is little enlargement of the second tooth in the inner row. The pharyngeal tooth formula is 2.3.5.-5.3.2.

DISTRIBUTION. Known only from Mawambi on the Ituri river (Congo system).

AFFINITIES. In its general shape, coloration, striations of the scales, scale and gill raker counts and pharyngeal teeth, *Barbus mirabilis* closely resembles *Barbus somereni*. The barbels are shorter than in *Barbus somereni* but the unique specimen of *Barbus mirabilis* is much bigger than the largest *Barbus somereni* examined. *Barbus somereni* also usually lacks the dark edge to the pectoral fin.

Without more specimens I cannot synonymize these two species nor state their relationship with any degree of certainty. It seems possible that, although *Barbus mirabilis* comes from the Congo system on the other side of the rift valley, it was found only some 150 km from the Ruwenzori mountains where *Barbus somereni* is common and could represent a population of *Barbus somereni* that lived in the westward-flowing rivers of that area and became isolated when the rift valley formed. There is a certain amount of circumstantial evidence to support this idea. *Barbus*

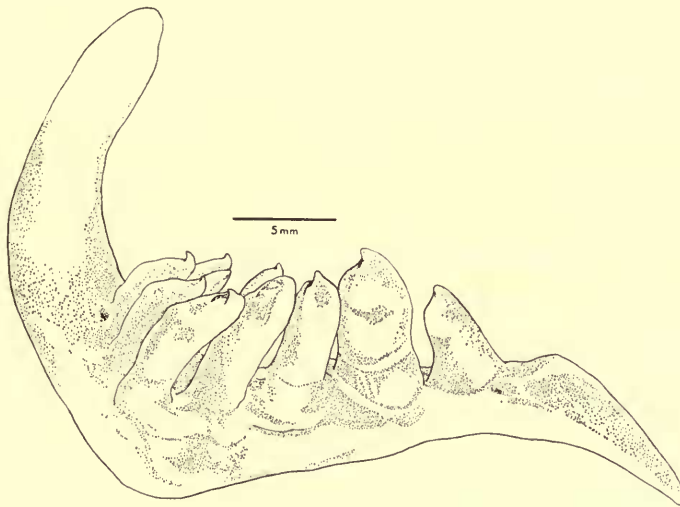


FIG. 75. The dorsal aspect of the left pharyngeal bone from the holotype of *Barbus mirabilis*.

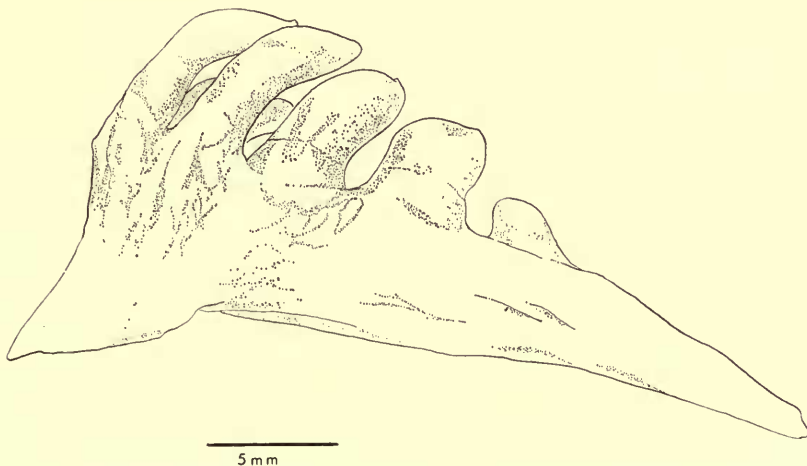


FIG. 76. The lateral aspect of the left pharyngeal bone from the holotype of *Barbus mirabilis*.

somereni has a wide, scattered distribution, usually at high altitudes suggesting that it was once a widespread species and changes in the environment (whether tectonic or climatic) or competition have driven it into higher altitude streams. What little geological evidence is available (see under *Barbus altianalis*) suggests that the Congo watershed extended further eastwards than it does now and that its eastern extremities were cut off and their direction changed by the rift valley formation. It would therefore seem possible that an old-established large *Barbus* species (which this must be if the arguments have any veracity at all) could be found on both sides of the rift valley. More specimens from Mawambi are badly needed before this matter can be pursued further. I have not been able to examine Pappenheim & Boulenger's (*op. cit.*) unique specimen of *Barbus mawambi* also from Mawambi but from their description and figure I am tempted to think that this species could be the same as *Barbus mirabilis*.

Barbus oxyrhynchus Pfeffer 1889

- Barbus oxyrhynchus* Pfeffer, 1889, *Jb. Hamb. Wiss. Anst.* **6** (2) pl. 8; Pfeffer, 1896, *Thierw. O-Afr. Fische* : 64.
Barbus tanensis Günther, 1894, *Proc. zool. Soc. Lond.* : 90, pl. 11; Blgr., 1911, *Cat. Afr. Fish* **2** : 58; Fowler, 1936 (Part), *Proc. Acad. nat. Sci. Philad.*, **88** : 287, fig. 50 (as *Barbus (Lanceabarbuis) tanensis*).
Barbus hindii Blgr., 1902, *Proc. zool. Soc. Lond.* (2) : 222, pl. 16, fig. 1; Pappenheim & Blgr., 1914, *Wiss. Ergebn. dt. ZentAfr. Exped. Zool.* (3) : 239; Pellegrin, 1909, *Mem. Soc. zool. Fr.* **22** : 281-298.
Barbus (Capoeta) perplexicans Blgr., 1902, *Proc. zool. Soc. Lond.* (2) : 223, pl. 16, fig. 2; Pellegrin, 1909, *Mem. Soc. zool. Fr.* **22** : 281-298.
Barbus labiatus Blgr., 1902, *Proc. zool. Soc. Lond.* (2) : 223, pl. 17, fig. 1.
Barbus krapfi Blgr., 1911, *Cat. Afr. Fish* **2** : 54.
Barbus mathoiae Blgr., 1911, *Cat. Afr. Fish* **2** : 66.
Barbus ahlSELLi Lönnberg, 1911, *K. svenska Vetensk. Akad. Handl.* **47** (6) : 39.
Barbus athi Hubbs, 1918, *Fieldiana* **12** (2) : 9-16.
†*Barbus babaulti* Pellegrin, 1926, *Bull. Soc. zool. Fr.* **51** : 384.
Barbus nairobi Holly, 1928, *Zool. Anz.* **75** (3-4) : 1-4.
Barbus donyensis Holly, 1929, *Sber. Akad. Wiss. Wien* (4) : 32-35.
Varicorhinus babaulti : Bertin & Esteve, 1947, *Catalogue des Types des Poissons Paris* : 45.

NOTES ON THE SYNONYMY. Pfeffer (1889) described *Barbus oxyrhynchus* from two small specimens from the Rufu river (Pangani system). *Barbus tanensis* was described from much larger fish (from 188 to 285 mm S.L.) from the Thika-Thika river (Tana system). *Barbus hindii*, *Barbus perplexicans*, *Barbus labiatus*, *Barbus krapfi* and *Barbus mathoiae*, all came from the Athi, Tana and Pangani rivers or the Lorian swamp, and they were separated principally on slight differences in propor-

† Pellegrin (1935, *Revue Zool. Bot. afr.* **27** : 382) subsequently described a small *Barbus* from Lake Kivu under the name *Barbus (Agrammobarbuis) babaulti*. Greenwood (1962) synonymized this species with *Barbus apleurogramma*, Blgr. 1911a. The International rules of Zoological Nomenclature (Arts. 53 and 60) require one to give a replacement name for *Barbus (Agrammobarbuis) babaulti*, Pellegrin 1935, which is here rejected as a primary junior homonym of *Barbus babaulti* Pellegrin 1926; I propose that Pellegrin's Lake Kivu species be called *Barbus lapsus*.

tion, especially of the lips, dorsal spine and body depth. The same characteristics were used to differentiate the other species from the same localities, viz. *Barbus ahliselli*, *Barbus athi*, *Barbus babaulti*, *Barbus nairobi* and *Barbus donyensis*.

Fowler (1936) was of the opinion that the continued separation of *Barbus hindii*, *Barbus tanensis* and *Barbus mathoiae* was unjustified. Allowing for the known vagaries of lip development (Groenewald 1958) and for the allometry of various parts of the body with growth it seems reasonable to conclude that all these nominal species from a few adjacent rivers are preferable to the same species. Certainly the adults have the same general appearance and, as the histograms indicate, normal variation (i.e. Poisson distribution) of various characters is present when large series of specimens are examined. The only species over which I have any doubts is *Barbus labiatus* (known only from two specimens) which has a shallower body and a slightly longer head than the others. But with only two specimens available I cannot attribute too much significance to slight differences.

It has not proved possible, using the characters considered useful in this paper, to divide *Barbus oxyrhynchus* into smaller groups. This is only to be expected as the overall range of morphometric characters is not very great and the head waters of the Athi and Tana systems are extremely close.

One fish (Coll. M.A.C.T. No. 47341) from the Malagarasi river was attributed to *Barbus krapfi* by David (1937) and to *Barbus lestradei* (= *Barbus caudovittatus*) by Poll (1953). *Barbus oxyrhynchus* has not been found in the Malagarasi, yet I cannot easily place this specimen with any of the Malagarasi species. The pectoral fin is slightly shorter than in *Barbus oxyrhynchus*, but in other features it corresponds well. I can only assume either that *Barbus oxyrhynchus* is found in the Malagarasi but is extremely rare or that this specimen is a deformed member of another species if it is not a new species.

A specimen in the Stockholm Museum, No. 8061, identified as *Barbus percivali* Blgr. (= *Barbus neumayeri* Fischer, *vide* Greenwood 1962 : 178) from Kibonoto on the Sanya river, belongs to *Barbus oxyrhynchus*.

There are two fish from the Ruaha river (Rufiji system) in the collection of the Central Africa Museum, Tervuren, which belong possibly to this species. The Rufiji is to the south of the Pangani and its fauna is very poorly known. These two fish are extremely deep bodied, their standard lengths are 156 and 164 mm with body depths of 38.4 and 40 per cent respectively. Their other features are within the *Barbus oxyrhynchus* range except for the dorsal spines which are short and articulated distally (respectively 11.5 and 15.2 per cent). Although at the moment, these specimens are considered as belonging to this species they are not included in the data given in the description below. Further specimens may show that the Rufiji fishes are of a different species or are a discrete population of *Barbus oxyrhynchus*. Pappenheim & Boulenger (1914) record *Barbus hindii* from the Ituri river but the very low lateral line count would seem to refer these fish to *Barbus mawambiensis*.

LECTOTYPE. The lectotype, a fish of 48 mm S.L. from the Pangani river, Hamburg Museum, No. H339, was selected by Ladiges *et alii* (1958). I have not been able to examine this specimen but it was compared for me by Dr W. Ladiges who

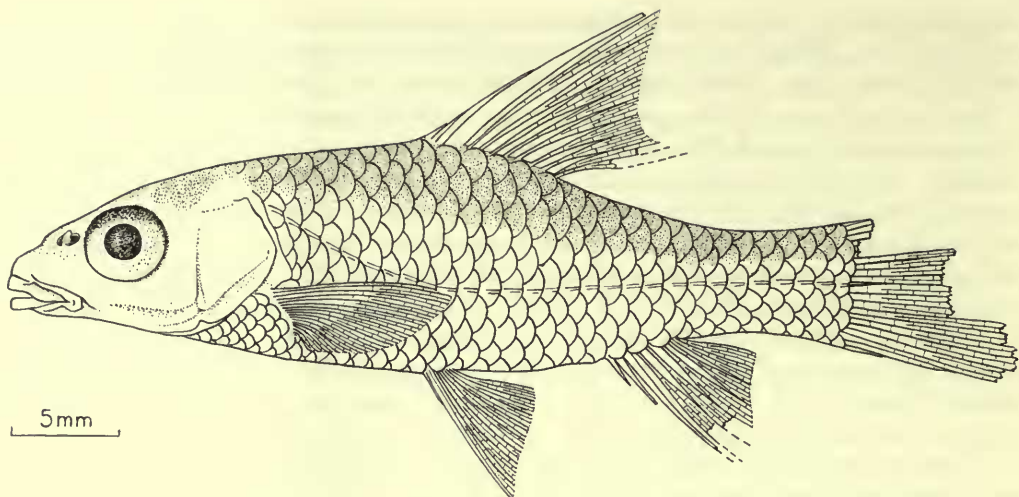


FIG. 77. *Barbus oxyrhynchus* paralectotype.

kindly sent me the largest paralectotype (40 mm S.L.) which is figured above (fig. 77).

DESCRIPTION. The description is based on 108 specimens, including, in addition to the types of *Barbus oxyrhynchus*, the types of *Barbus tanensis*, *Barbus hindii*, *Barbus perplexicans*, *Barbus labiatus*, *Barbus krapfi*, *Barbus mathoiae*, *Barbus ahlseelli*, *Barbus babaulti* and *Barbus athi*. The size range of the specimens is from 28 to 369 mm S.L. Because the lectotype is a juvenile fish figs. 78, 79 and 80 show larger specimens indicating the variations produced by growth in this species.

The morphometric data are expressed in tabular form as follows and unless otherwise stated are expressed as a percentage of the standard length.

	\bar{x}	s.d.	s.e.	range
D	31.8	2.8	0.3	26.1-39.4
H	26.9	2.5	0.2	23.0-32.6
I	7.6	1.9	0.2	4.4-11.1
IO	8.9	1.1	0.1	6.9-12.5
MW	6.4	0.9	0.1	4.3- 8.7
Pct	24.4	1.9	0.2	21.3-28.6
CPl	16.9	1.4	0.1	14.1-20.0
CPd	12.8	1.1	0.1	10.8-15.5
Snt	8.5	0.9	0.1	6.3-11.0
Ab	5.9	1.4	0.1	3.1-10.7
Pb	7.1	1.4	0.1	3.6-12.4

The standard deviation is higher than for many species described in this paper because of the size range and marked allometry of the specimens examined. This is especially noticeable in the body depth; in fishes of less than 100 mm S.L. (measurements expressed as a percentage of the standard length unless otherwise

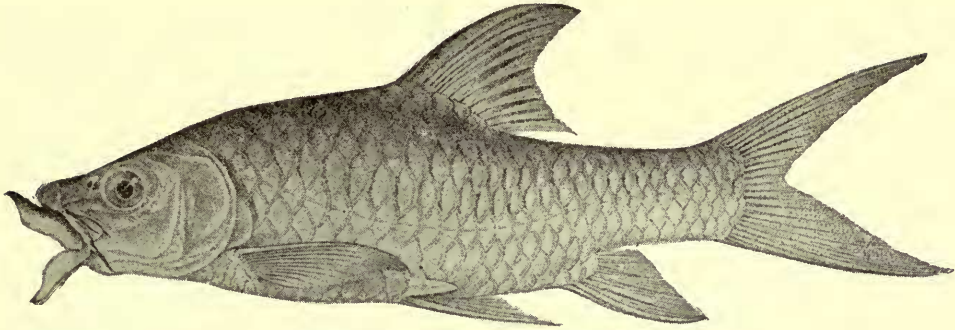


FIG. 78. *Barbus oxyrhynchus* (type of *B. labiatus* from Boulenger 1911a).

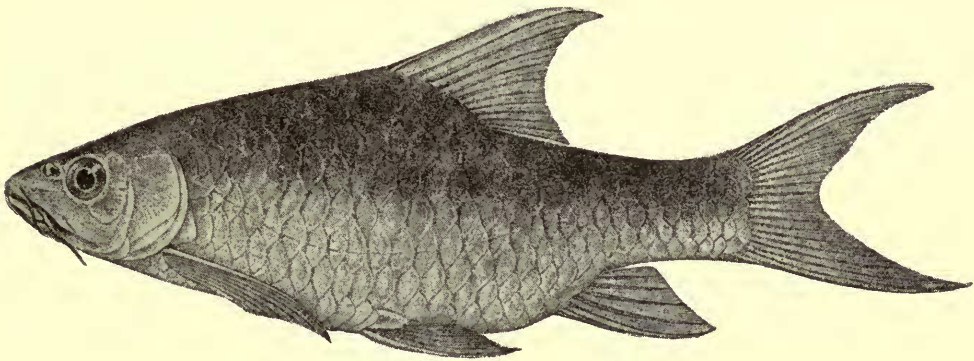


FIG. 79. *Barbus oxyrhynchus* (type of *B. hindii* from Boulenger 1911a).

stated), $\bar{x} = 29.3$; s.d. = 2.2; s.e. = 0.4; range = 26.1–35.0; the upper end of this range is extended by two small fishes from the Athi river which have a pronounced keel leading up to the dorsal fin. Fishes of S.L. 101–170 mm, $\bar{x} = 32.2$; s.d. = 1.6; s.e. = 0.2; range = 29.5–35.8. Fishes of S.L. above 171 mm, $\bar{x} = 33.6$; s.d. = 2.7; s.e. = 0.5; range = 28.4–39.4. In this case the lower end of the range is extended by the shallow-bodied specimens previously referred to *Barbus labiatus* (see below).

The typical adult fish has a fairly flat ventral profile. The dorsal profile rises sharply from the snout to the origin of the dorsal fin after which it follows a sloping concave course down to the caudal fin. The same type of body shape is shown by the two specimens attributed to *Barbus labiatus* except that the body is less deep. The snout is obtusely pointed. The mouth ranges from ventral and curved in most specimens through the wide, cutting mouth of the types of *Barbus perplexicans* to the rubber lips of the type of *Barbus labiatus*. The mean length for the pectoral fin is sufficiently great for it to serve as a diagnostic character for the species.

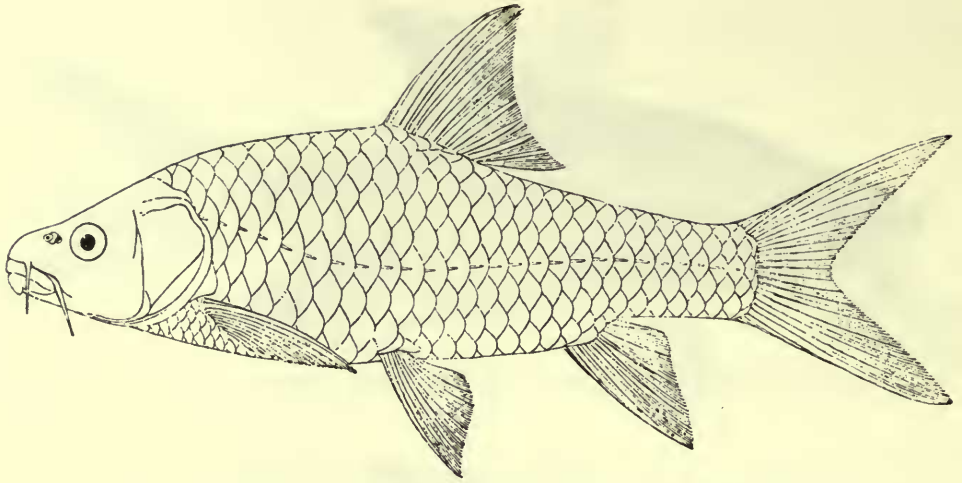
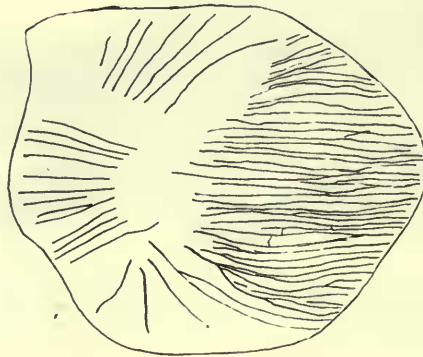


FIG. 80. *Barbus oxyrhynchus* (type of *B. krapfi* from Boulenger 1911a).



5mm

FIG. 81. A scale from a specimen of *Barbus oxyrhynchus* (the type of *B. mathoiae*) to show the distribution of the striae.

The caudal peduncle is compressed, short and deep with a mean length/depth ratio of 1:32.

Squamation. The scales bear many parallel or slightly converging striae (fig. 81). The lateral line count is low, from 21 to 28 scales; 21 (f.1), 22 (f.10), 23 (f.15), 24 (f.36), 25 (f.30), 26 (f.8), 27 (f.6), 28 (f.1). The type of *Barbus labiatus* has 24 on one side and 27 on the other. The lateral line follows a rather dipping course. There are 4.5 (f.100) rarely 3.5 (f.6) or 5.5 (f.2) scales between the dorsal mid-line and the lateral line and 4.5 (f.81) rarely 3.5 (f.16) or 5.5 (f.3) scales between the lateral line and the ventral mid-line. This count was unobtainable from some

specimens. There are 2.5 (f.65), 2 (f.4) or 1.5 (f.32) scales between the lateral line and the base of the pelvic fin. Again this count was not possible in some specimens. Around the caudal peduncle there are 12 (f.99) or 11 (f.5) scales; this count too was unobtainable for some specimens.

Dorsal fin. There are four unbranched rays. The last of these is ossified into a long, moderately broad, straight or gently curving spine. This fourth ray has a mean length of 25.3 with a range from 16.6 to 35.7 per cent, s.d. = 4.6, s.e. = 0.5.

There are from eight to ten branched rays: 8 (f.5), 9 (f.82), 10 (f.21); the types of *Barbus oxyrhynchus* are somewhat atypical in having only eight branched rays. The dorsal margin is strongly concave and the base of the dorsal fin frequently has an enveloping sheath of scales.

The *anal fin* has three unbranched rays and five (very rarely six) branched rays.

Pharyngeal bones and teeth. The pharyngeal tooth formula is constant at 2.3.5.-5.3.2. The first tooth in the inner row is tall, thin and has a slightly hooked crown. It is slightly angled towards the second tooth. This tooth is longer than wide (fig. 83) and again hooked distally. Teeth 3, 4 and 5 become progressively thinner and develop articular surfaces on the posterior face of the crown. The fifth tooth is distinctly recurved but the terminal hook remains. The teeth of the second and third rows resemble the fifth tooth of the ventral row in general shape but are much smaller.

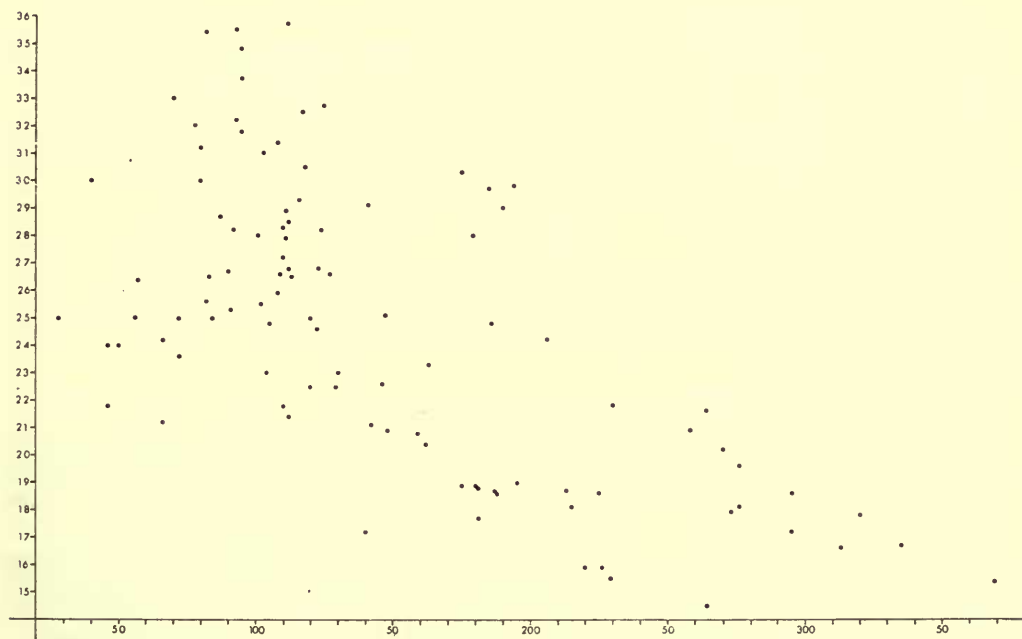


FIG. 82. Scatter diagram of the dorsal spine length as a percentage of the standard length against the standard length for the entire sample of *Barbus oxyrhynchus*.

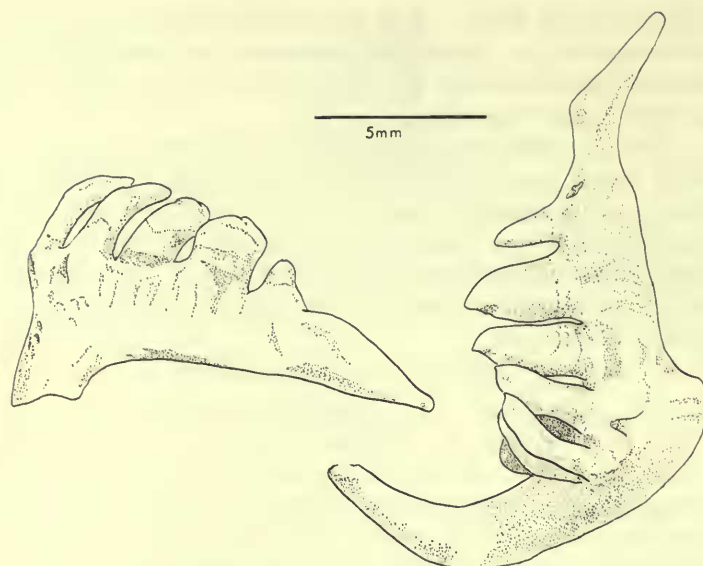


FIG. 83. The left pharyngeal bone from *Barbus oxyrhynchus* (a syntype of *B. tanensis*).

The *gill rakers* range from 11 to 16 on the lower limb of the first gill arch.

Coloration. Copley (1958) states that the colour of *Barbus tanensis* varies in live fish from olive-green to deep olive-brown on the back shading to silver on the belly. Fowler (1936) figures *Barbus tanensis* with a dark spot on the caudal peduncle; I have not seen this in any of the specimens I examined. The colour in alcohol is sandy-brown on the back shading to a pale brown to silver on the belly. The scale margins are frequently a deeper shade of brown than the centre of the scale.

DISTRIBUTION. Specimens are known from the Rufu river, Pangani system; the Kibwesi, Makindu, Tsavo, Regati, Mathoiya and Thika-Thika rivers, Athi-Tana systems; the Rufiji river; Nero-Narok system, Lorian swamp (in the Northern Euasso Nyiro system). This species is widespread throughout the Athi and Tana systems (Copley 1958).

The locality G. el Narua given in Boulenger (1911a:57) is the subject of some dispute and is discussed in detail on p. 71.

I have not had the opportunity to examine any *Barbus* specimens from Mozambique north of the Zambezi so it is possible that the range of *Barbus oxyrhynchus* may extend further south.

DIAGNOSIS AND AFFINITIES. *Barbus oxyrhynchus* is closely related to *Barbus bynni*, *Barbus gananensis* and *Barbus longifilis* and the points of differences between *Barbus oxyrhynchus* and the three other species will be found on pp. 36 and 129.

Comments on clinal phenomena within this group of species and exemplified by *Barbus oxyrhynchus* are found on p. 129.

***Barbus pagenstecheri* Fischer 1884**

Barbus pagenstecheri Fischer, 1884, *Jb. hamb. wiss. Anst.* 1: 30; Pfeffer, 1896, *Thierw. O.-Afr. Fische* 5: 65; Boulenger, 1911, *Cat. Afr. Fish* 2: 72.

LECTOTYPE. The original description was based on two specimens (Nos. H341 and H342 in the Hamburg Museum of 315 and 217 mm S.L. respectively). Boulenger (1911a) redescribed the species on the basis of the smaller specimen and implied that this specimen was the lectotype (he used the word 'type' and mentioned that a larger specimen had also been referred to this species). Ladiges *et alii* (1958), in a non-revisional work, designated the larger specimen (H341) as the lectotype. Here I follow Boulenger in accepting the smaller specimen as the lectotype and regarding the larger specimen as the paralectotype.

DESCRIPTION. The description is based on the only two specimens referred to this species. The morphometric data are shown below and in each case the lectotype comes first. L = 217, 315 mm; D = 26.3, 29.8; H = 24.0, 30.8; I = 6.4, 4.8; IO = 7.4, 10.2; MW = 6.9, 8.9; Pct = 20.3, 24.8; CP1 = 17.5, 17.5; CPd = 10.1, 12.3; Snt = 6.9, 9.8; Ab = 4.1, 5.1; Pb = 5.2, 6.4.

Unless otherwise stated all measurements are expressed as percentages of the standard length.

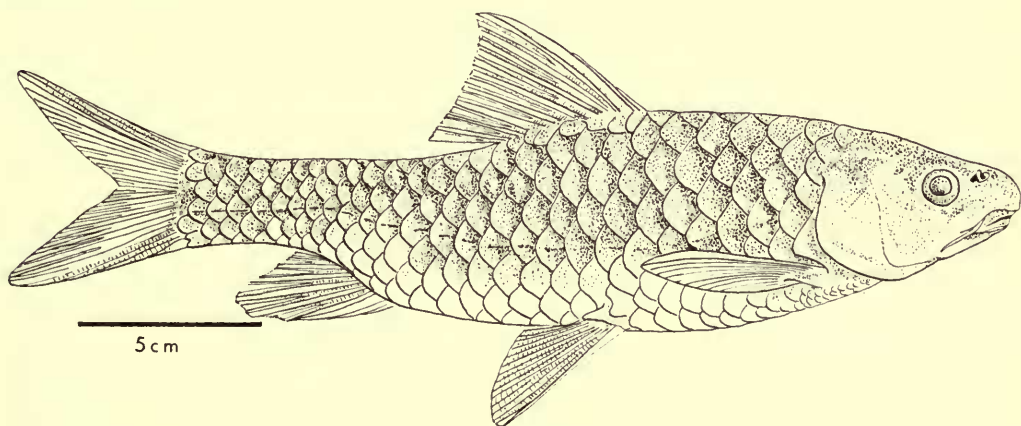


FIG. 84. *Barbus pagenstecheri* lectotype.

The body (fig. 84) is elongated, the dorsal profile rises gradually and smoothly from the snout to the origin of the dorsal fin. The caudal peduncle is about half as long again as it is deep. The mouth is sub-terminal with a sharp edge to the lower jaw in the lectotype but rubber lips are developed in the paralectotype. The snout is blunter in the lectotype than in the paralectotype. Both specimens have a clearly defined rostral groove. Numerous small tubercles are present on the snout and the cheeks of both specimens.

Squamation. There are 26 or 27 scales in the lateral line series, 4.5 (f.2) scales between the dorsal mid-line and the lateral line, 4.5 (f.2) scales between the lateral line and the ventral mid-line and 2.5 (f.2) scales between the lateral line and the

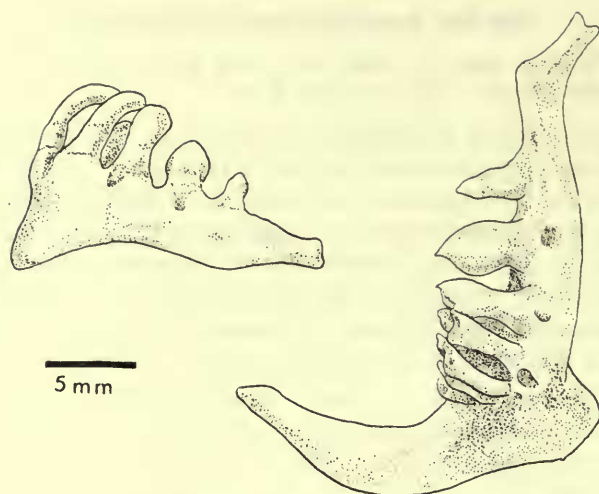


FIG. 85. *Barbus pagenstecheri* – dorsal and lateral views of the left pharyngeal bone.

base of the pelvic fin. Twelve scales encircle the caudal peduncle. The exposed parts of the scales bear numerous, sinuous, more or less parallel striae.

Dorsal fin. There are four unbranched rays and eight branched rays in the dorsal fin. The last unbranched ray is weakly ossified into a smooth spine, 14.3, 13.7 per cent S.L. The dorsal margin of the fin is slightly concave. The dorsal fin origin is slightly in advance of the pelvic fin origin.

The *anal fin* has three unbranched rays and five branched rays.

Pharyngeal bones and teeth. Pharyngeal bones are present only in the paralectotype. The pharyngeal teeth number 2.3.5.-5.3.2. The teeth are widely spaced (fig. 85). The lateral flange is confined to the angle of the bone level with the fourth and fifth teeth of the inner row.

Gill rakers. There are 12 or 15 gill rakers on the lower limb of the first gill arch.

Coloration. The colour of alcohol-preserved specimens is dark brown on the back paling to yellow-brown on the ventral surface. The edges of the scales on the back and dorsal part of the flanks are lighter than the centres. The fins are dark grey-brown.

DISTRIBUTION. Fischer (1884) collected the fish from a stream flowing down Mount Kilimanjaro. Bailey (1969) gives the locality as in the Pangani system. There is no evidence for this because only the streams on the south face of Mount Kilimanjaro flow into the Pangani. The streams on the eastern face flow into the Tsavo river whilst the streams on the northern and western faces have no outlet to the sea. All of the streams are covered by the locality description 'German East Africa'. Detailed information on the expeditions' collecting sites is lacking.

DIAGNOSIS AND AFFINITIES. *Barbus pagenstecheri* is a species of uncertain affinities, its distribution is localized and it is surrounded by waters containing *Barbus*

oxyrhynchus. I have not seen any specimens, nor have I been able to find any reliable records, of *Barbus oxyrhynchus* from the Kilimanjaro region and it is therefore possible that the two specimens referred to *Barbus pagenstecheri* may represent a local population of *Barbus oxyrhynchus*. The differences between these two fishes and equal-sized specimens of *Barbus oxyrhynchus* are marked. The former fishes have shallow bodies and weak dorsal spines whilst the latter have deeper bodies and strong dorsal spines. The lateral line scale count in *Barbus pagenstecheri* is at the upper end of the *Barbus oxyrhynchus* range and the scale striations are similar in both species. *Barbus mariae* from the Athi river can easily be distinguished from *Barbus pagenstecheri* by its 'rhinoceros horn' (see p. 84). With only two specimens available it is, I feel, preferable to maintain the species *Barbus pagenstecheri* rather than to regard these specimens as local variants of *Barbus oxyrhynchus*. Further collections from the Kilimanjaro region are needed to reach a satisfactory conclusion.

***Barbus paucisquamatus* Pellegrin 1935**

Barbus altianalis var. *labiosa* (part) Pellegrin, 1933, *Bull. Soc. zool. Fr.* **58**: 169 (only the paratype, from Loama).

Barbus altianalis var. *paucisquamata* Pellegrin, 1935, *Revue Zool. Bot. afr.* **27** (3): 378.

Barbus altianalis var. *longifilis* (part) Pellegrin, 1935, *Revue Zool. Bot. afr.* **27** (3): 378 (only the specimen from Nyabarongo).

Barbus altianalis var. *lobogenysoides* Pellegrin, 1935, *Revue Zool. Bot. afr.* **27** (3): 380.

NOTES ON THE SYNONYMY. The specimens of the varieties of *Barbus altianalis* described by Pellegrin (*op. cit.*) which came from rivers in the Congo system constitute a species distinct from *Barbus altianalis*.

The name *labiosa*, although the oldest infra-specific name, is not available for this newly defined species as the holotype of that variety (a fish from Lake Kivu) is a specimen of *Barbus altianalis altianalis*. The type series of *Barbus altianalis* var. *paucisquamata* is homogeneous and the infra-specific name *paucisquamata* (when the gender is changed to form *paucisquamatus* - Article 30) is available and is used accordingly.

There are certain inaccuracies in the original description of the specimens of *Barbus altianalis* var. *paucisquamata*. Pellegrin (1935: 379) lists three specimens of lengths $130 + 35 = 165$, $140 + 40 = 180$, $130 + 35 = 165$. The measurements presumably refer to the standard length, 'tail fin' length and the total length. The three syntypes (Paris Museum Nos. 35-76, 35-77, 35-78 are of 124, 164 and 116 mm S.L. respectively. M.A.C.T. specimen 42932 is registered as a 'co-type', there is a label with this fish saying 'co-type, don. de Mus. Paris Loc. Kivu, réc. Guy Babault'. This fish is of 177 mm S.L.

LECTOTYPE. Specimen 35-76 in the Paris Museum is designated the lectotype. This specimen of 124 mm S.L. is closest in size to any of the Pellegrin measurements. It is also the only specimen with a precise locality which is Kitembo, Nyabarongo river.

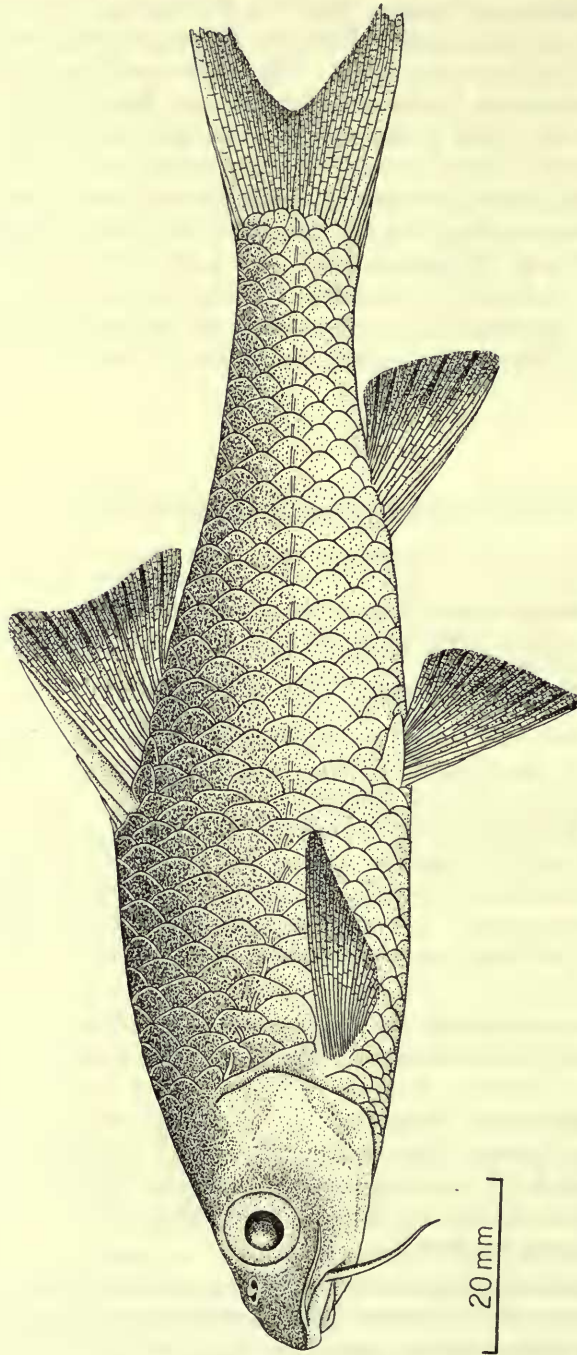


FIG. 86. *Barbis paucisquamatus* lectotype.

DESCRIPTION. The description is based on 12 specimens from 80 to 248 mm S.L.

	\bar{x}	s.d.	s.e.	range
L				80 -248 mm
D	26.8	1.6	0.5	24.0-30.0
H	25.5	1.3	0.4	23.8-27.6
I	7.2	1.2	0.3	5.4- 9.4
IO	7.6	0.9	0.2	6.3- 8.5
MW	5.8	0.4	0.1	5.2- 6.2
Pct	21.2	0.9	0.3	20.2-22.8
CPI	18.0	1.2	0.3	16.4-19.7
CPd	11.0	1.0	0.3	9.4-13.0
Snt	8.0	0.9	0.3	6.8- 9.3
Ab	7.5	1.4	0.4	5.8-10.6
Pb	8.6	1.7	0.4	6.2-11.2

All measurements are expressed as percentages of the standard length. The body is compressed. The dorsal profile of the snout is curved, the ventral profile is flat. The mouth is ventral and horse-shoe shaped. The lower lip is well defined and varies between continuous with a slight mental lobe and medially discontinuous. The upper lip forms the ventral edge of the snout. The barbels are conspicuously long.

Squamation. The lateral line has 27 (f.3), 28 (f.4) or 29 (f.5) scales. Between the dorsal mid-line and the lateral line there are 4.5 (f.12) scales. Only seven specimens were in sufficiently good condition for the scales between the lateral line and the ventral mid-line to be counted; five specimens have 4.5 scales and two specimens have 5.5 scales. Two and a half scales are present between the lateral line and the pelvic fin insertion. There are 12 scales around the caudal peduncle.

The striae on the scales are numerous and more or less parallel. The striae of scales on the upper part of the body tend to diverge slightly whilst scales on the lower part of the body tend to have striae that are parallel or slightly converging.

Dorsal fin. The dorsal fin has four unbranched rays, the last one is ossified into a smooth, straight or slightly curved spine ($\bar{x} = 19.7$; s.d. = 2.7; s.e. = 0.8; range 14.1-22.5). There are nine (f.11) or eight (f.1) branched rays. The dorsal margin of the fin is only very slightly concave. The origin of the dorsal fin is in front of the origin of the pelvic fins.

Pharyngeal bones and teeth. No exceptions to the pharyngeal tooth formula 2.3.5.-5.3.2. were found. The teeth are shown in fig. 87. The anterior edentulous process has its distal half at an angle to the proximal half.

Gill rakers. There are 11 (f.3) or 10 (f.3) on the lower limb of the first gill arch in the six specimens examined.

Coloration. All the preserved specimens are dark fish. Dark-brown pigment is present on the distal parts of the dorsal, anal, pelvic and pectoral fins. On the caudal fin the pigment is concentrated at the margins.

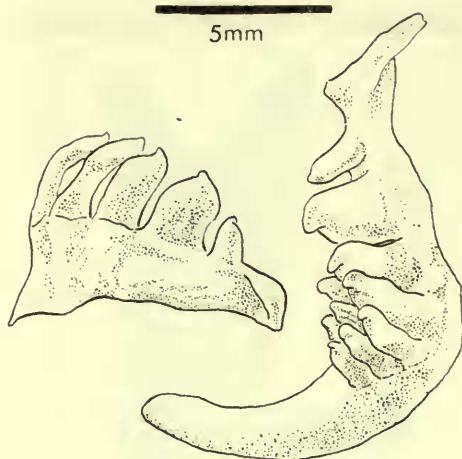


FIG. 87. *Barbus paucisquamatus* – left pharyngeal bone from the lectotype.

The body is dark brown but the scales have a noticeably high reflectivity. The skin of the cheeks and snout has a silvery layer below the brown pigment. The dorso-lateral surface of both barbels, particularly the anterior barbel, is pigmented.

DISTRIBUTION. Known from the Loama river, the Nyabarongo river and the Luhoho Congo.

DIAGNOSIS AND AFFINITIES. *Barbus paucisquamatus* is a fish with 27–29 scales in the lateral line series, dark pigment widespread over the body but not obscuring a very silvery layer beneath and scales on which the striae vary with the position of the scale on the body.

Its affinities are uncertain as there is an absence of clear-cut similarities or distinctions with other species. It is sympatric with *Barbus longifilis* from which it can be distinguished by its shorter barbels, shallower body and weaker dorsal spine.

Although *Barbus paucisquamatus* was described as a variety of *Barbus altianalis*, the caudal peduncle is conspicuously longer and shallower than in that species, and the overall impression gained from the body shape and colour is that there is no close relationship between *Barbus altianalis* and *Barbus paucisquamatus*.

The heavy pigmentation and a similar mouth are also found in *Barbus caudovittatus* (p. 40) but at the moment I do not have enough information to comment further on the possibilities of a relationship between these two species, nor between *Barbus paucisquamatus* and the morphologically somewhat similar *Barbus trachypterus*.

***Barbus platyrhinus* Boulenger 1900**

Barbus platyrhinus Blgr., 1900, *Ann. Mag. nat. Hist.* (7) 6 : 479.

HOLOTYPE. A fish of 347 mm S.L. from Usamburu, Lake Tanganyika, B.M. (N.H.) Reg. No. 1906.9.6 : 12.

DESCRIPTION. Based upon seven specimens, the holotype and six fishes M.A.C.T. Nos. 89789-92, 130658-60.

	\bar{x}	s.d.	s.e.	range
L				57 -347 mm
D	29.6	2.4	0.9	26.1-32.3
H	25.7	1.0	0.4	24.2-27.2
I	7.2	0.9	0.4	6.3- 9.1
IO	9.8	0.9	0.3	8.2-10.9
MW	6.7	0.9	0.3	5.7- 8.1
Pct	21.4	1.3	0.5	19.6-23.7
CPI	16.5	1.1	0.4	15.2-18.7
CPd	12.2	0.8	0.3	10.9-13.7
Snt	8.8	0.6	0.3	7.6- 9.5
Ab	3.4	0.7	0.3	2.1- 4.3
Pb	4.5	0.5	0.2	3.6- 5.2

Barbus platyrhinus is a heavy-bodied fish, the bulky appearance becoming more exaggerated in larger specimens. The mouth is ventral and the snout has a slightly bulbous profile above the upper jaw.

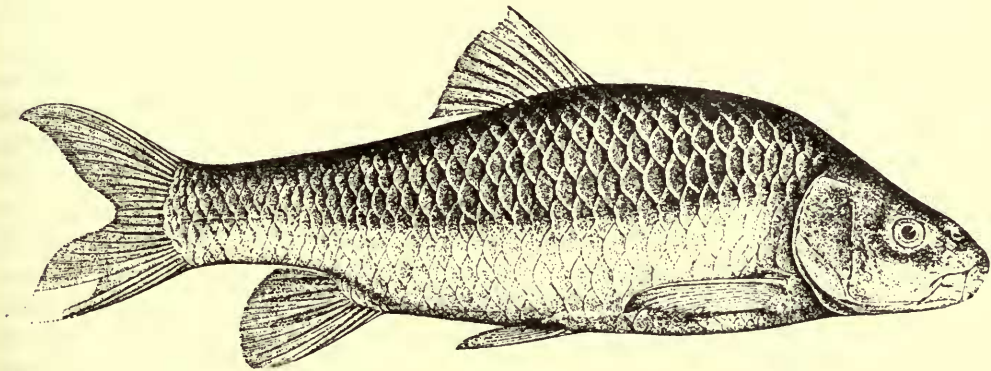


FIG. 88. *Barbus platyrhinus* holotype (from Boulenger 1911a).

Squamation. The lateral line follows a fairly straight course. The dip in the middle of the line is shallow. The lateral line scale counts are 38 (f.2), 39 (f.3), 40 (f.1), 41 (f.1). There are 6.5 (f.1) or 7.5 (f.6) scales between the dorsal mid-line and the lateral line. There are 6.5 (f.1), 7.5 (f.2), 8.5 (f.4) scales between the lateral line and the ventral mid-line. There are 3.5 (f.2) or 4.5 (f.4) scales between the lateral line and the base of the pelvic fin. Sixteen (f.3) or 18 (f.4) scales encircle the caudal peduncle, the scales are longitudinally striated.

Dorsal fin. The dorsal fin has four unbranched rays. The last unbranched ray ranges from 10.1 to 24.6 per cent S.L. with a mean value of 18.1 per cent. There are 8 (f.1), 9 (f.5) or 10 (f.1) branched rays. The origin of the dorsal fin is slightly in advance of the origin of the pelvic fins.

The *anal fin* has three unbranched rays and five branched rays.

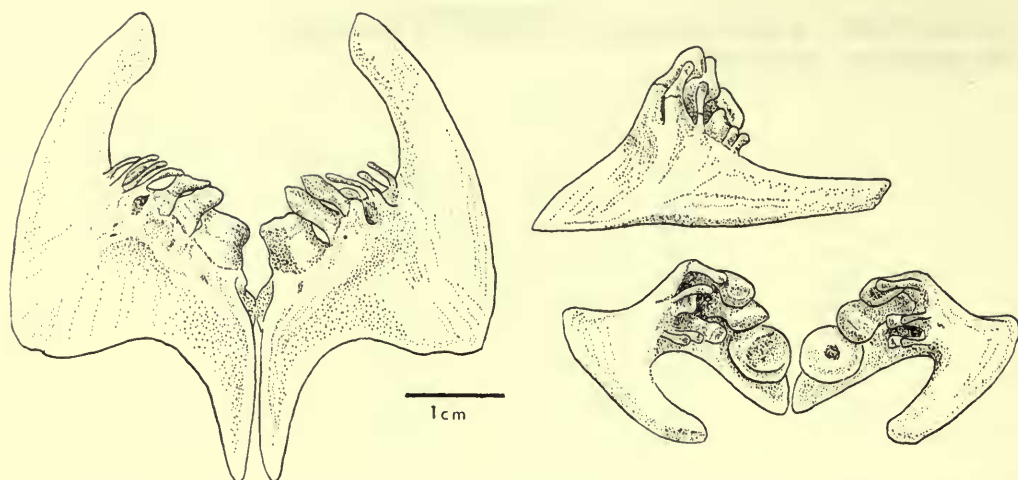


FIG. 89. The pharyngeal bones from the holotype of *Barbus platyrhinus*.

Pharyngeal bones and teeth. The only pharyngeal bones that I have been able to examine are from the holotype and are apparently aberrant (fig. 89); the pharyngeal formula is 4.3.2. The inner row lacks the first tooth present in other species, the first tooth present in *Barbus platyrhinus* is the homologue of the usual second tooth and is referred to as the second tooth. The second tooth is large and molariform. The third tooth has a rounded crown wider than long with a slight concavity in the posterior face of the left-hand tooth and a deep concavity in the anterior face of the right-hand tooth. The fourth tooth is smaller than the preceding, the anterior edge of the crown is its highest point and the posterior face is concave. This tooth is wider than it is long. The fifth tooth is slight and its spatulate crown is very close to the preceding crown. On the left-hand bone the first tooth of the middle row is missing but the scar is present. Its counterpart is mamilliform and wider than long. It is physically closer to the anterior tooth of the dorsal row than to the second tooth of the middle row. The second and third teeth become progressively smaller. They are complete on the left-hand bone but either aberrant or in the process of being replaced on the right-hand bone. The two small teeth in the outer row are wider than long with a concave posterior face.

The pharyngeal bones themselves are short and thick.

There are between 11 and 13 broad, bilobed *gill rakers* on the lower part of the first gill arch.

DISTRIBUTION. This species has been recorded at Usamburu and Uvira, Lake Tanganyika and from the Koki river, an affluent of Lake Tanganyika. Poll (1953) believes that it is rare in the lake and may be commoner in the affluent rivers.

DIAGNOSIS AND AFFINITIES. This species is sympatric with *Barbus tropidolepis* to which, at the very least, it is closely related. Both species have a high number of lateral line scales and similarly shaped pharyngeal teeth. The major difference

between them is the development of the fatty ridges on the scales in *Barbus tropidolepis* and the universal presence of barbels in *Barbus platyrhinus*. A larger series of specimens of this species and some information on their ecology may show that they are not a valid species, but for the moment it must be retained as there is, in some characters, no overlap. I have not yet found any fish which cannot with certainty be placed in either *Barbus platyrhinus* or *Barbus tropidolepis*, but the specimens examined have been few in number. The possibility that *Barbus platyrhinus* is a hybrid must also be borne in mind.

Barbus ruasae Pappenheim and Boulenger 1914

Barbus ruasae Pappenheim and Blgr., 1914, *Wiss. Ergebn. dt. ZentAfr. Exped. Zool.* (3) 5 : 238, pl. 2, fig. 2.

LECTOTYPE. The lectotype is the smaller of the two type specimens of Pappenheim & Boulenger, a fish of 155 mm total length and 126 mm S.L. This is the specimen figured by the authors. The lectotype and paralectotype (a fish of 128 mm S.L.) are in the Zoological Museum, Berlin, both registered as ZMB 19053. The locality is Mkunga in Rwanda.

DESCRIPTION. The description is based on five specimens, the two from Mkunga (see above) and three specimens, M.A.C.T. Nos. 91755, 91756, 92214, from the Nyabugogo, an affluent of the Lusine about 64 km SSE of the type locality.

	\bar{x}	s.d.	s.e.	range
L				103 - 135 mm
D	25.6	1.6	0.7	23.7-28.1
H	27.0	0.9	0.4	25.8-28.1
I	8.6	0.6	0.3	8.0- 9.7
IO	7.3	0.3	0.1	7.0- 7.8
MW	6.5	1.0	0.4	5.6- 8.0
Pct	21.8	2.2	1.0	18.3-23.4
CPI	16.2	1.3	0.6	14.7-18.4
CPd	10.6	0.5	0.2	10.1-11.5
Snt	8.4	0.5	0.2	7.8- 8.9
Ab	5.3	1.7	0.7	2.4- 7.1
Pb	6.1	1.8	0.8	3.2- 8.0

All measurements are expressed as a percentage of the standard length. The mouth is ventral, the anterior margin of the lower jaw is curved and the upper and lower lips developed but not lobed. The barbels in the lectotype show signs of damage. The head is pointed, the dorsal margin of the body rises in a smooth curve from the snout to the origin of the dorsal fin. The lateral line count is 25 (f.9) or 26 (f.1) (both sides of the fish considered). The smallest of the M.A.C.T. specimens has the count of 26 on one side. There are 4.5 scale rows between the dorsal mid-line and the lateral line and 4.5 from there to the ventral mid-line. Two and a half scales are between the lateral line and the base of the pelvic fin and 12 scales

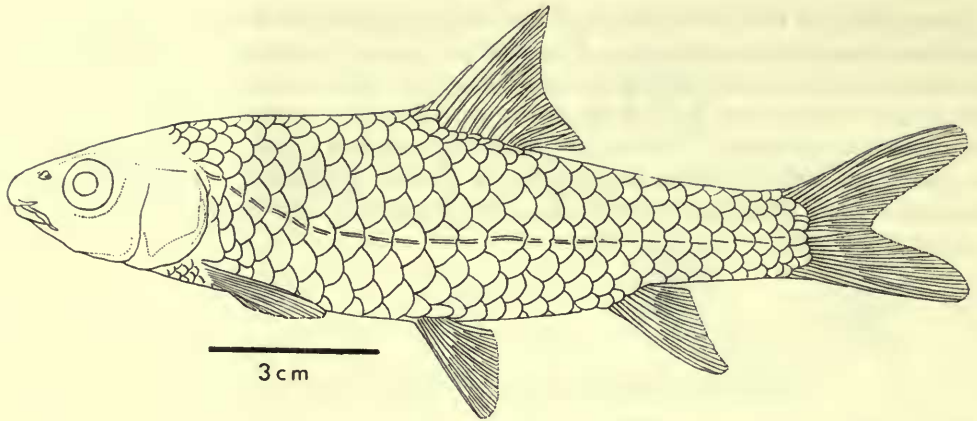


FIG. 90. *Barbus ruasae* lectotype.

encircle the caudal peduncle. The striae on the scales are parallel and much wider apart on the scales of the pectoral region than on the scales of the caudal peduncle. The dorsal fin has four unbranched rays, the last is ossified into a strong smooth spine ($\bar{x} = 21.0$; s.d. = 2.9 ; s.e. = 1.3 ; range $18.6-26.0$). There are 8 (f.2), 9 (f.2) or 6 (f.1) branched rays. The dorsal fin with six branched rays showed obvious signs of damage. The origin of the dorsal fin is above or slightly anterior to the origin of the pelvic fin. A low sheath of scales surrounds the base of the dorsal fin.

The *anal fin* has three unbranched and five branched rays.

Pharyngeal bones and teeth. The pharyngeal bones are moderately slender, the teeth are in three rows of 5.3.2. on each bone. The second tooth in the inner row of the largest M.A.C.T. specimen (No. 992214) is more molariform than in the lectotype.

There are from 10 to 13 *gill rakers* on the lower limb of the first gill arch.

Coloration. In alcohol the fish present a silvery appearance. The back is a mid-brown which shades to silver on the belly. The centres of the scales are bright silvery and the edges are darker. Traces of dark pigment remain in the middle of the caudal fin, the distal edge of the dorsal fin, the anal fin and the posterior margins of the pectoral and pelvic fins.

DIAGNOSIS AND AFFINITIES. *Barbus ruasae* is a member of the *Barbus intermedius* complex and as such it is compared with and distinguished from *Barbus acuticeps* on p. 8, *Barbus altianalis* on p. 27 and *Barbus intermedius* on p. 140.

Pappenheim & Boulenger (*op. cit.*) thought, prophetically, that *Barbus ruasae* showed affinities to *Barbus leptosoma* (= *Barbus intermedius*).

Very low lateral line counts are found in *Barbus mawambiensis*. This species is found in the not-too-distant Ituri and Ja rivers which although in the Congo system do not flow into the Lake Victoria basin. I do not have enough information to

determine whether or not there is any relationship between *Barbus ruasae* and *Barbus mawambiensis*.

My knowledge of the *Barbus* species of the Congo is insufficient to even hazard any opinions on the relationships of the species concerned.

Barbus somereni Boulenger 1911

Barbus somereni Blgr., 1911, *Ann. Mag. nat. Hist.* (8) 8 : 369 ; Greenwood, 1966, *The Fishes of Uganda* 2nd ed. : 69 ; Banister, 1972, *Bull. Br. Mus. nat. Hist.* (Zool.) 24 (5) : 261-290.

Barbus altianalis urundensis David, 1937, *Revue Zool. Bot. afr.* 9 (4) : 414.

Barbus urundensis Poll, 1946, *Anns. Mus. r. Congo Belge* (1) 4 (3) : 185-188.

HOLOTYPE. A fish of 172 mm S.L., B.M. (N.H.) Reg. No. 1911.7.26 : 1 from the Sibwe river, Ruwenzori mountains, Uganda.

DESCRIPTION. The description is based on 51 specimens, 66-279 mm S.L. All measurements are expressed as percentages of the standard length.

	\bar{x}	s.d.	s.e.	range
D	29.5	2.9	0.4	25.4-38.4
H	29.9	1.4	0.2	21.6-28.8
I	7.6	1.4	0.2	5.2-10.6
IO	8.5	1.1	0.1	6.7-11.7
MW	7.5	0.8	0.1	6.3-9.2
Pct	22.2	1.7	0.2	18.4-28.0
CPl	16.3	1.3	0.2	13.9-19.0
CPd	11.6	0.7	0.1	10.4-13.2
Snt	8.6	0.6	0.1	7.6-10.2
Ab	7.8	1.0	0.1	5.6-9.6
Pb	8.6	1.2	0.2	6.3-11.6

The body is slightly compressed and becomes relatively deeper in larger fishes. This and the relative decrease in the diameter of the eye with an increase in the

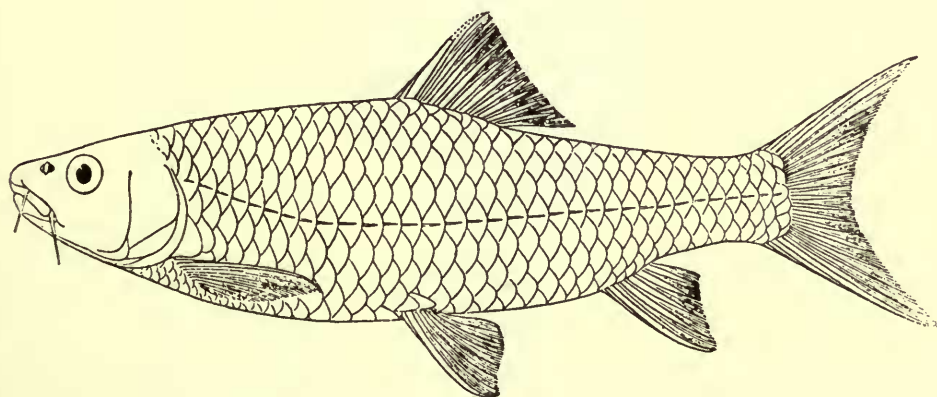


FIG. 91. *Barbus somereni* holotype (from Boulenger 1916).

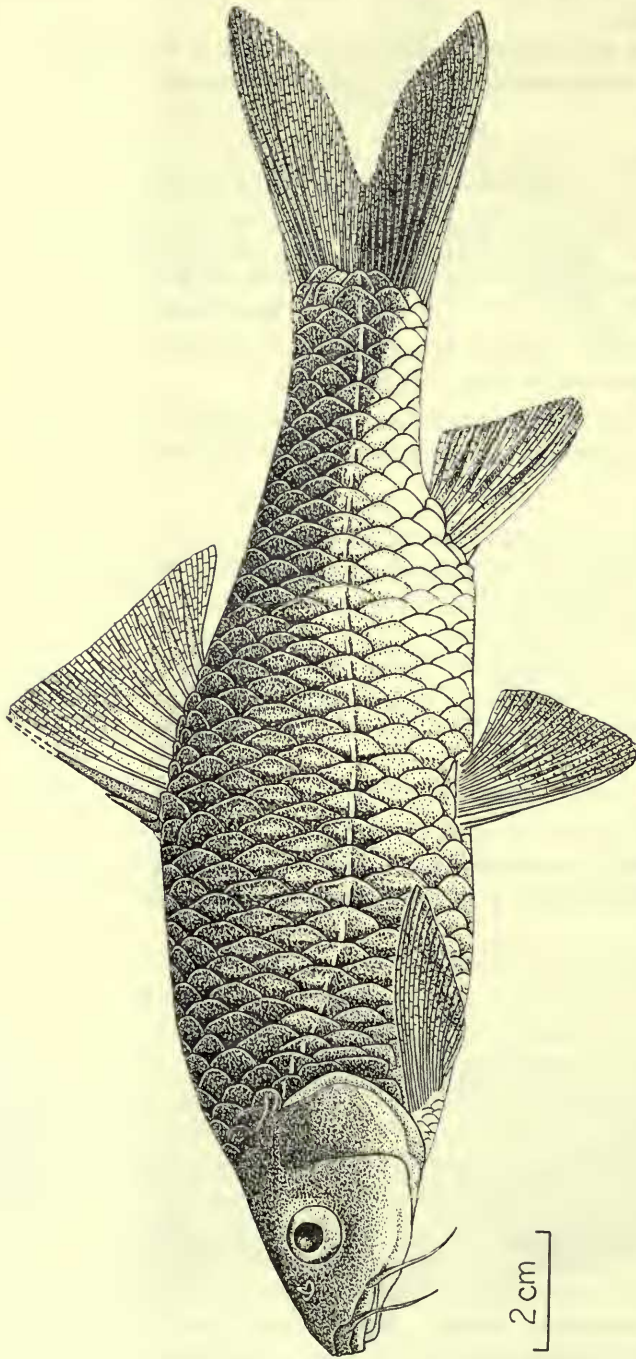


FIG. 92. A specimen of *Barbus somereni* from the Sibwe river, Uganda, displaying the typical features of the species and the colour pattern which is not shown on the holotype.

standard length are the only obvious signs of allometric growth. In the other measurements, the scatter of the points precludes the determination of the direction of the allometry.

The mouth is sub-inferior and usually has continuous, moderately developed lips, but a 'rubber-lipped' specimen was collected in the Sibwe river.

Three fish from the Malagarasi river were described by David (1937) as *Barbus altianalis wrundensis*. I find that her three syntypes (M.A.C.T. Reg. Nos. 46963-46965) have IV-8 (f.1), IV-9 (f.2) rays in the dorsal fin (not III-9 as described) and have 31 (f.1), 32 (f.1), 33 (f.1) scales in the lateral line. Her counts were of the total number of scales.

Squamation. The number of scales in the lateral line ranges from 26 to 34: 26 (f.1), 27 (f.2), 28 (f.3), 29 (f.5), 30 (f.11), 31 (f.12), 32 (f.7), 33 (f.7), 34 (f.1).

The pattern of striae on the scales varies between that which is regarded as typically radiate and that which is typically parallel. There is a general tendency for the shoulder scales in this species to be of the latter type and the belly scales to be of the former. The striae are, however, more numerous than is usual for the classical radiately striated *Barbus* (see fig. 93).

There are 5.5 (sometimes 4.5 rarely 6.5) scales between the dorsal mid-line and the lateral line and 4.5-6.5 (rarely 7.5) scales between the lateral line and the ventral mid-line. The specimens from the Sibwe and Tokwe rivers (Lake George affluents) have 3.5 scales between the lateral line and the pelvic fin, whilst those from Mahembe and the Mutamphu river (Kagera system) have 2.5 scales (rarely 2 or 3).

There are 12 scales round the caudal peduncle.

Dorsal fin. There are four unbranched rays, the last is ossified with a smooth posterior margin. This is also true for the type specimen although Boulenger (1911b) describes only three unbranched rays. The length of the last unbranched ray varies from 8.7 to 21.2 per cent of the standard length ($\bar{x} = 13.8$). There are nine or ten branched rays except in one fish where there are eight.

The *anal fin* has three unbranched and five branched rays.

Coloration. The ripe-running males in the Sibwe river have a deep olive-brown back which changes sharply into an ochrous yellow colour on the flanks and belly. The dark olive on the back is continued into the lower lobe of the caudal fin. The upper caudal lobe and the dorsal fin are pale brown. This pattern of a dark back and dark lower caudal lobe persists in fishes which are sexually inactive and is also visible in the great majority of preserved specimens.

Gill rakers. There are 8-11 gill rakers on the lower limb of the first arch. The rakers are bilobed with the sharply triangular outer lobe the larger.

The pharyngeal bones and teeth. The teeth are slightly hooked with no significant enlargement or molarization of the second tooth on the inner row (fig. 94). The pharyngeal tooth formula is 2.3.5.-5.3.2.

DISTRIBUTION. Specimens are known in the Ruwenzori area from the following rivers: Sibwe river, Mubuku river, Tokwe river and Kirimia river. In the Sibwe and Mubuku rivers which flow into the northern end of Lake George, *Barbus somereni*

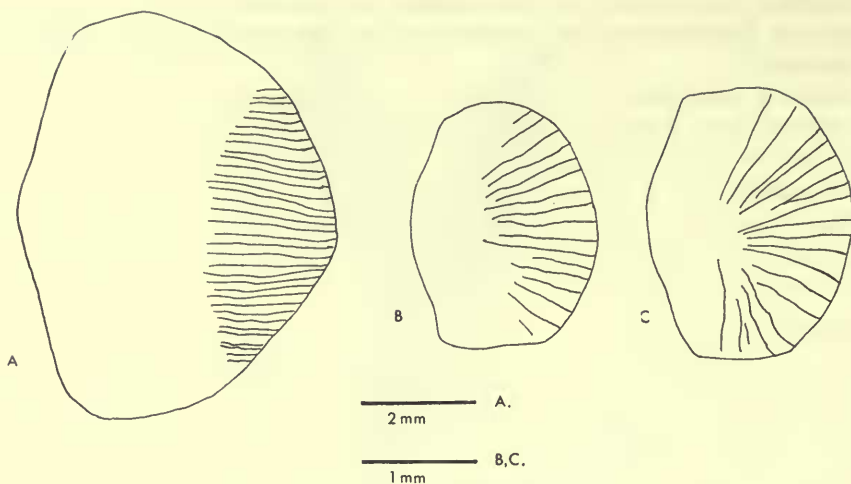


FIG. 93. Scales from the shoulders of A) *Barbus bynni*, B) *B. somereni*, C) *B. humilis* to compare the striae on the *B. somereni* scales with the typically 'parallel' and 'radiate' striae patterns shown by the other two species.

lives in the faster-flowing reaches before the rivers meander into the lake. Greenwood (1966) gives 5500 feet as the upper limit of *Barbus somereni* distribution. *Barbus somereni* is not common in the Mubuku river (see Banister 1972).

Barbus somereni has also been found in the Nyawarongo (at Mahembe) and Akianaru (Rwanda) rivers, in the Mutamphu river (12 km from Astrida on the road to Shangugu), in the Chirangobwe river (Lake Kivu basin), Mwogo river (Kagera system), upper Malagarasi river (Burundi), Kitenge river (Ruzizi) and from the Nyamagana and Nyakagunda rivers (Burundi).

DIAGNOSIS AND AFFINITIES. The relationship between *Barbus somereni* (and its relative *Barbus mirabilis*) and the other African *Barbus* species is uncertain. The body shape, the last simple dorsal fin ray, the number of dorsal fin rays, the nature of the striae on the scales and the colour pattern are all points of difference between *Barbus somereni* and the members of the *Barbus bynni* and *Barbus intermedius* complexes (especially *Barbus altianalis*), which are the closest groups geographically.

Barbus somereni is a species which lives at higher altitudes than, for example, *Barbus altianalis eduardianus* in the Lake George–Ruwenzori Mountain region. This could suggest that *Barbus somereni* has been displaced by *Barbus altianalis* and, if so, then *Barbus somereni* is a longer established resident of the area. This view is strengthened by the presence of *Barbus mirabilis* on the other side of the rift valley.

Barbus somereni is possibly related to *Varicorhinus ruwenzorii*. These two species live in the same area, have the same colour pattern and it is suggested (Banister 1972) that they hybridize.

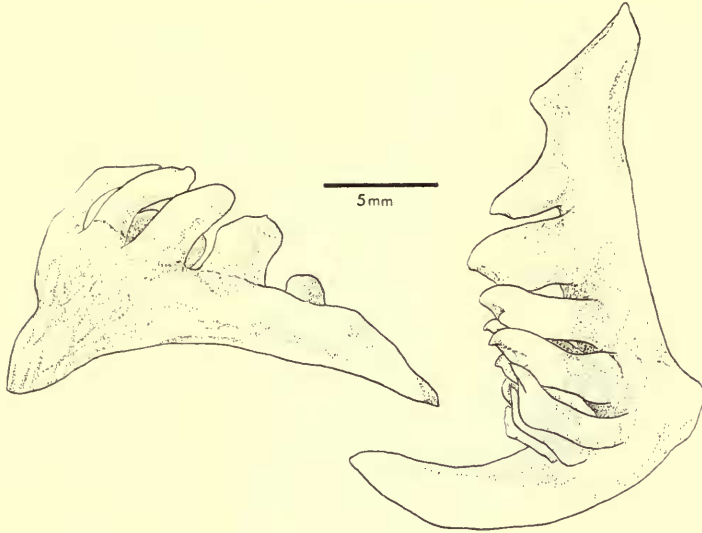


FIG. 94. The dorsal and lateral aspects of the left pharyngeal bone from *Barbus somereni*.

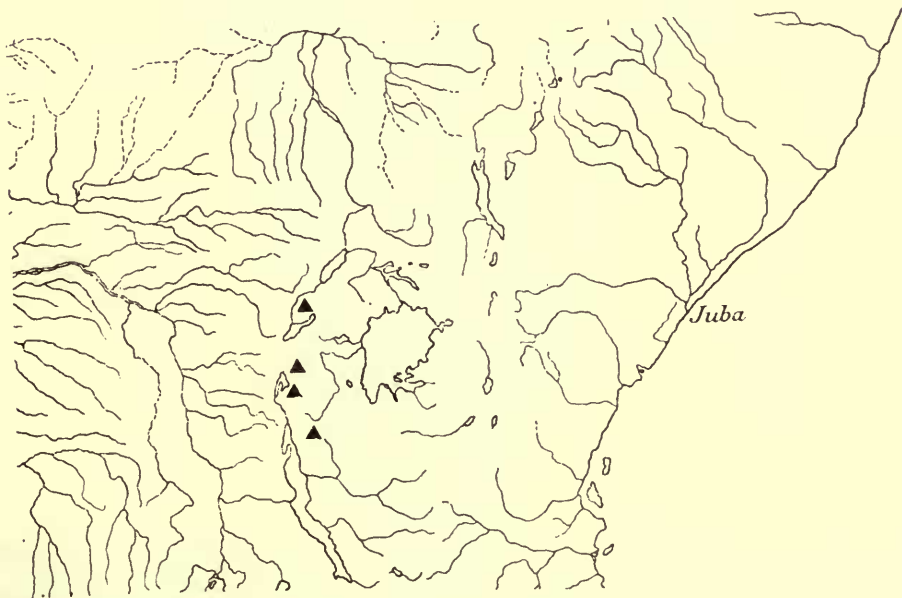


FIG. 95. A map of the distribution of *Barbus somereni*.

Barbus stappersii Boulenger 1915

Barbus stappersii Blgr., 1915, *Revue zool. afr.* **4** (2) : 165 ; Blgr., 1920, *Revue zool. afr.* **8** (1) : 13 ; Jackson, 1961, *Fishes of Northern Rhodesia* : 57.

Barbus curtus Blgr., 1915, *Revue zool. afr.* **4** (2) : 165 ; Blgr., 1920, *Revue zool. afr.* **8** (1) : 14 ; Jackson, 1959, *Occ. Pap. natn. Mus. Sth. Rhod.* No. 23B : 298 ; Soulsby, 1960, *Nth. Rhod. J.* **4** (4) : 329, fig. 10.

Barbus oxycephalus Blgr., 1915, *Revue zool. afr.* **4** (2) : 165 ; Blgr., 1920, *Revue zool. afr.* **8** (1) : 15 ; Soulsby, 1960, *Nth. Rhod. J.* (4) : 329, fig. 11.

Barbus moeruensis Pellegrin, 1922, *Revue zool. afr.* **10** (3) : 273 ; Pellegrin, 1928, *Annls. Mus. r. Congo Belge* (1) **3** : 42.

NOTES ON THE SYNONYMY. Jackson (1961) synonymized *Barbus curtus*, *Barbus oxycephalus* and *Barbus moeruensis* with *Barbus trachypterus* Blgr. 1915. These four species and *Barbus stappersii* were each described from single specimens, all from Lake Mweru, and all except *Barbus trachypterus* are large fish, respectively their standard lengths are 233 mm, 264 mm, 594 mm, 128 mm and 283 mm.

These nominal species fall into two obvious groups, one with the caudal peduncle as deep as it is long and the other with the caudal peduncle much longer than deep. The former group consists of the types of *Barbus stappersii*, *Barbus oxycephalus*, *Barbus curtus* and *Barbus moeruensis* whilst the latter group contains *Barbus trachypterus*. The caudal peduncle depth is the most trenchant difference between the two groups although there are others. The size difference has had no effect upon the dimensions of the caudal peduncle, a specimen of 112 mm S.L. referable to *Barbus stappersii* has a caudal peduncle deeper than it is long.

Barbus trachypterus is considered here to be a valid species and is described on p. 119.

HOLOTYPE. A fish of 283 mm S.L., M.A.C.T. No. 14250, from Lake Mweru.

DESCRIPTION. The description is based on nine specimens ranging from 103 to 594 mm S.L.

	\bar{x}	s.d.	s.e.	range
D	35.6	3.8	1.1	30.0-40.7
H	25.5	1.2	0.4	25.0-28.2
I	6.6	1.3	0.4	4.1- 8.7
IO	9.8	1.4	0.4	7.7-12.3
MW	7.6	1.4	0.4	6.2-10.8
Pct	24.0	2.2	0.7	18.6-26.0
CP1	15.1	1.4	0.5	13.0-17.9
CPd	15.4	1.7	0.5	12.0-17.4
Snt	9.1	0.8	0.2	8.0-10.8
Ab	2.7	0.9	0.3	1.8- 3.9
Pb	3.6	0.7	0.2	2.8- 4.5

They are stocky, deep fish with moderately compressed bodies. The ventral profile is gently convex from the mouth to the anal fin whilst the dorsal profile ascends steeply towards the dorsal fin. The mouth is terminal, the lips moderately developed and with a median lobe on the lower lip. All the examined specimens

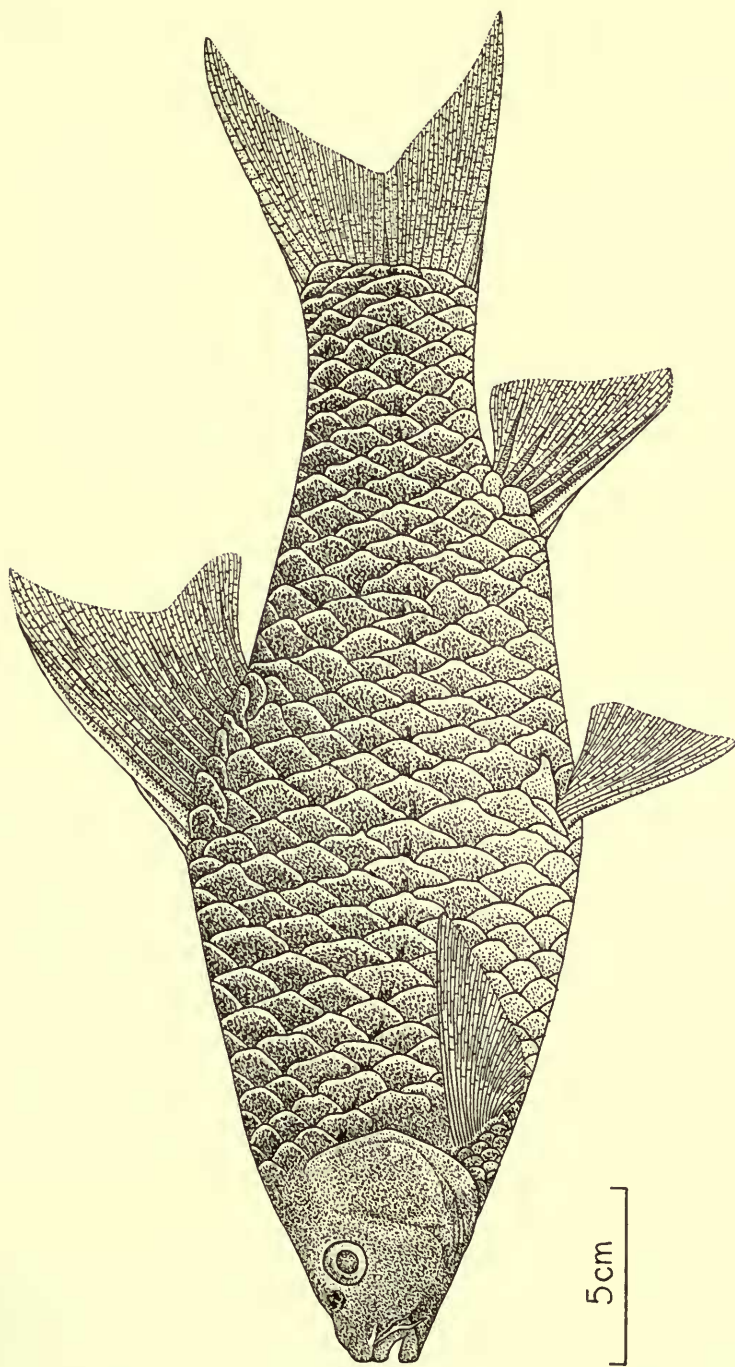


FIG. 96. *Barbus stappersii* holotype.

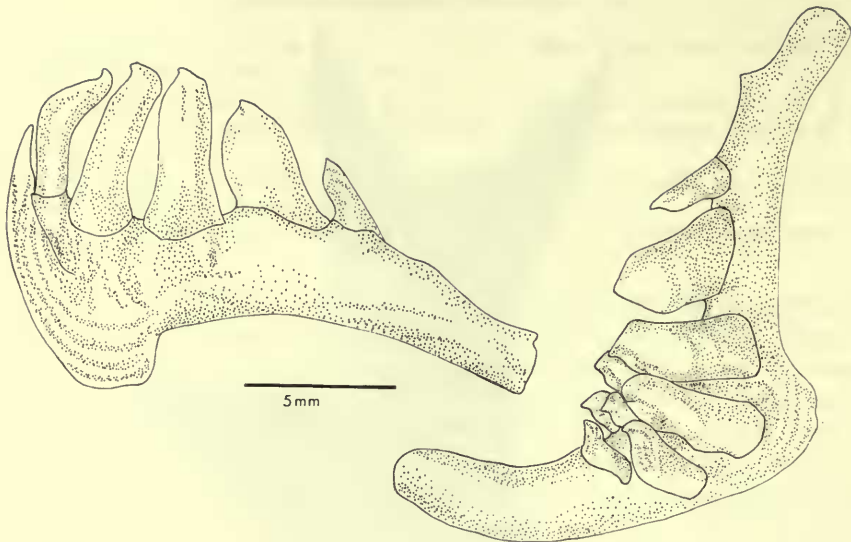


FIG. 97. The dorsal and lateral aspects of the left pharyngeal bone of the holotype of *Barbus stappersii*.

have lips conforming to this pattern, except for a specimen from Kilwa in which the lips are thinner.

The caudal peduncle is as deep as it is long.

Dorsal fin. The leading edge of the dorsal fin is slightly in advance of the origin of the pelvic fin. A low basal sheath of scales is present. The anterior edge of the dorsal fin is high and curved so that the concave dorsal margin is positioned almost vertically. The dorsal spine is moderately well ossified, the measurements of the non-flexible basal part in the nine specimens are $\bar{x} = 16.0$, s.d. = 3.88, s.e. = 1.37 and the range is 9.1 to 21.8 per cent. There are 9 (f.2) or 10 (f.7) branched rays.

The *anal fin* has three unbranched rays and five branched rays.

Squamation. The scales have numerous parallel striae. The lateral line has between 23 and 28 scales: 23 (f.1), 24 (f.3), 25 (f.2), 26 (f.1), 27 (f.1), 28 (f.1). There are 4.5 scale rows between the dorsal mid-line and the lateral line and 4.5 (f.8) or 5.5 (f.1) scales between the lateral line and the ventral mid-line. Two and a half scales are present between the lateral line and the pelvic fin base. There are 12 scales around the caudal peduncle.

Pharyngeal teeth and bones. The pharyngeal tooth formula is 2.3.5.-5.3.2., the pharyngeal bone (fig. 97) is moderately slender. The crowns of the inner row of teeth are curved. There is little enlargement of the second tooth on the inner row, the first tooth on that row is small with a slightly spoon-shaped crown and it is angled towards the second tooth. The succeeding teeth in that row become higher, more slender and more recurved. The tip of the fifth tooth is hooked forwards.

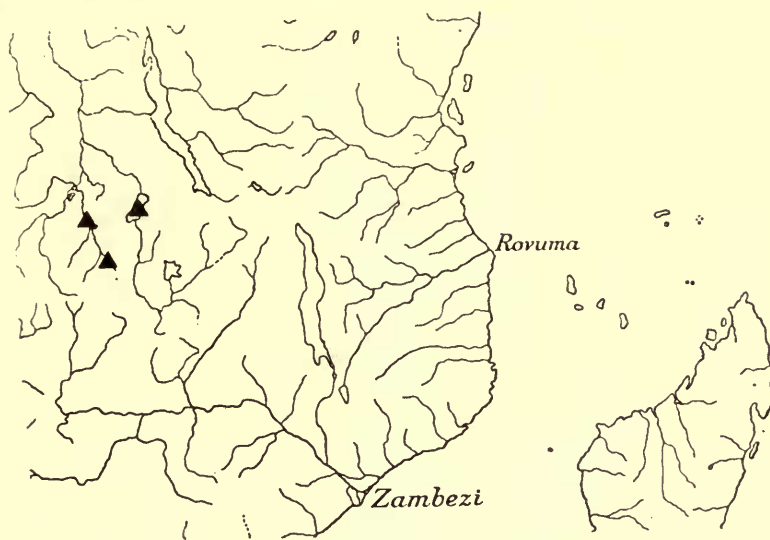


FIG. 98. A map of the distribution of *Barbus stappersii*.

Gill rakers. There are 13 curved gill rakers on the lower limb of the first gill arch.

Coloration. The colour in alcohol-preserved specimens is uniformly brown, with the centre of each scale a richer, deeper brown than the posterior margin.

DISTRIBUTION. This species is known from Kilwa, on Lake Mweru, and from the Lubumbashi region.

DIAGNOSIS AND AFFINITIES. *Barbus stappersii* is a species easily recognized by its short, deep caudal peduncle, low number of scales in the lateral line series (23–28) and by the high anterior edge of the dorsal fin.

Its affinities are uncertain. In some respects (short, deep caudal peduncle and high dorsal fin) it resembles specimens of *Barbus marequensis* A. Smith from the Zambezi river (the forms described as *Barbus victoriae* Blgr., *Barbus altidorsalis* Blgr., *Barbus chilotes* Blgr., *Barbus codringtonii* Blgr. and *Barbus fairbairnii* Blgr.). A low watershed is the only barrier between the Upper Zambezi and the Lake Mweru basin. Until I have examined more specimens of *Barbus marequensis* and *Barbus stappersii* I am reluctant to comment further on any relationship between these two species.

***Barbus trachypterus* Boulenger 1915**

Barbus trachypterus Blgr., 1915, *Revue zool. afr.* **4** (2) : 164 ; Jackson (*partim*) 1961, *Fishes of Northern Rhodesia* : 58.

Varicorhinus bredoi Poll, 1948, *Bull. Mus. r. Hist. nat. Belg.* **24** (21) : 9.

HOLOTYPE. A fish of 128 mm S.L., M.A.C.T. No. 11380, from the hydrographical station, Lake Mweru.

DESCRIPTION. The description is based on 17 specimens from 54 to 239 mm S.L.

	n	\bar{x}	s.d.	s.e.	range
L					54 - 239 mm
D	17	27.9	1.6	0.4	25.6-31.4
H	17	25.4	2.5	0.6	21.8-28.8
I	17	5.4	1.0	0.2	3.8- 7.4
IO	17	7.7	1.3	0.3	6.0-11.4
MW	17	6.4	0.7	0.2	5.4- 7.6
Pct	17	21.0	1.4	0.3	18.9-22.6
CPl	17	17.4	1.3	0.3	14.5-19.3
CPd	17	10.7	0.9	0.2	9.1-11.8
Snt	17	8.2	1.1	0.2	6.5-11.4
Ab	16	3.5	1.0	0.2	2.4- 5.5
Pb	16	4.9	1.4	0.3	2.6- 8.0

All measurements are expressed as percentages of the standard length.

The body is slightly compressed with a level or gently convex ventral profile and a dorsal profile which rises evenly from the snout to the dorsal fin origin (fig. 99). The mouth is ventral and semi-circular. The upper lip is visible in the ventral view as a thin, fleshy surround to the mouth. The thin rostral flap reaches down to the level of the mouth. The anterior edge of the lower jaw is strongly convex in outline. In small fishes a fleshy lower lip, often with a small mental lobe, is present, but in larger fishes the tendency is for the lower jaw to have a flat, cutting anterior margin. One specimen (M.A.C.T. No. 129097) has well-developed 'rubber lips'.

Tubercles are present on the snout and cheeks of several specimens. The tubercles are comparatively small, but widespread and tend to coalesce. In specimens M.A.C.T. Nos. 165254-165256 they are present on the snout, cheeks, operculum and anal fin rays. They are also present on the anal fin rays of the holotype.

In three comparatively fresh specimens (M.A.C.T. Nos. 165254-165256), the peritoneum is black.

Squamation. The scales possess numerous parallel or, at the most, slightly converging striae. There are from 27 to 31 scales in the lateral series: 27 (f.4), 28 (f.4), 29 (f.5), 30 (f.2), 31 (f.2). Twelve scales are invariably present around the caudal peduncle. There are 4.5 (f.15) or 5.5 (f.1) scales between the dorsal mid-line and the lateral line and 5.5 (f.10) or 4.5 (f.3) scale rows between the lateral line and the ventral mid-line except in one specimen (M.A.C.T. No. 129100 of standard length 168 mm) where the scales on the chest are conspicuously reduced. There are 2.5 or 3 scales between the lateral line and the base of the pelvic fins.

Dorsal fin. Except for the holotype of *Varicorhinus bredoi* the dorsal fin has four unbranched rays. This specimen now has only two unbranched rays although Poll (1948) records three. There is little doubt that the reduction in the number of simple rays in this specimen is the result of physical damage. The last unbranched ray is ossified into a smooth, often slightly curved spine: \bar{x} = 20.0; s.d. = 2.48; s.e. = 0.6; range = 16.1-25.0. The dorsal fin is slightly in advance of the pelvic fin origin. There are 8 (f.3), 9 (f.12) or 10 (f.2) branched rays.

The *anal fin* has three unbranched and five branched rays.

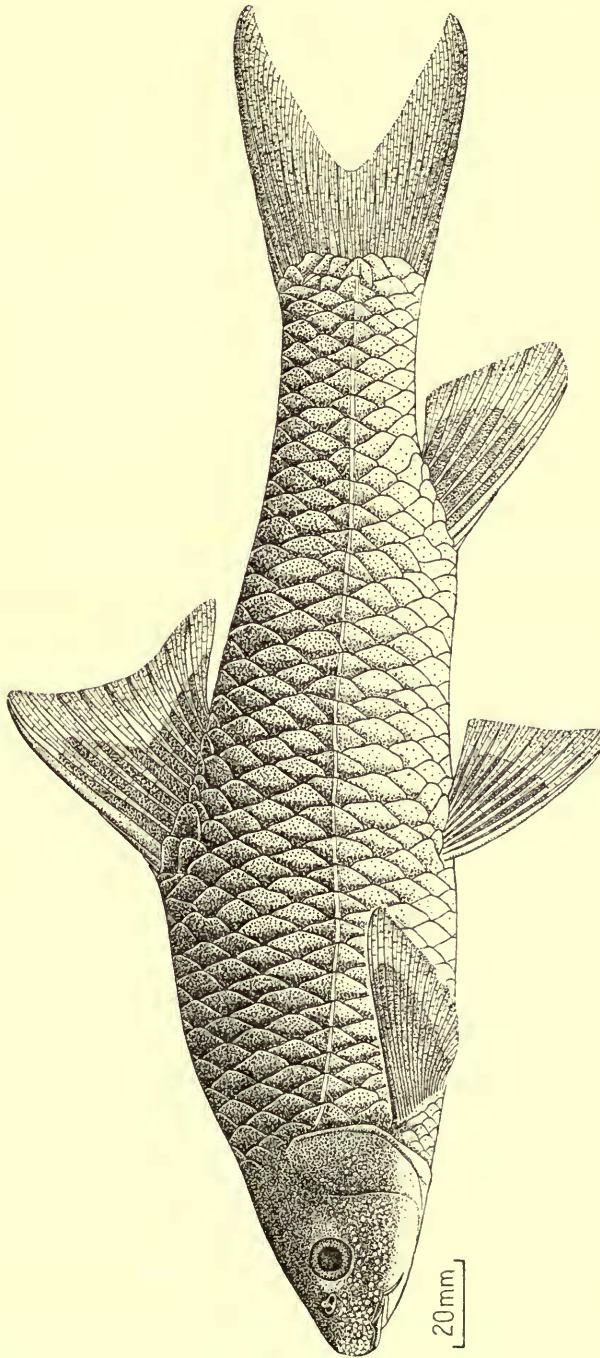


FIG. 99. *Barbus trachypterus*, a specimen from Lake Mweru of 148 mm S.L.

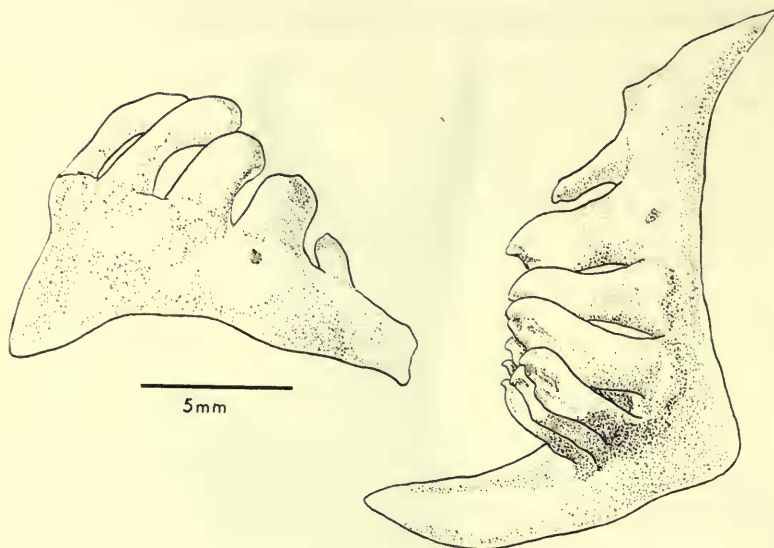


FIG. 100. The dorsal and lateral aspects of the left pharyngeal bone from the figured specimen of *Barbus trachypterus*.

Pharyngeal bones and teeth. The pharyngeal tooth formula is 2.3.5.-5.3.2. The pharyngeal teeth are small, slender and crowded (fig. 100). The second tooth of the inner row has a tendency to become molariform; in six of the nine specimens examined the crown is rounded and flattened at the top. The pharyngeal bone is thick and stout, but less so than in *Barbus caudovittatus* specimens of the same size (cf. figs. 22 and 23).

Gill rakers. The gill rakers number between 11 and 13 on the lower arm of the first gill arch.

Coloration. The colour pattern is invariably different from that of *Barbus caudovittatus* with which some of these specimens have been confused. The black upper half of the sides are mid-brown with darker brown bases to the scales. The lower part of the flanks, chest and belly are pinkish-brown. Dark pigment is present on the proximal half of the membrane of the dorsal, anal, pelvic and pectoral fins. The caudal fin has a uniform mid-brown colouring. The colour notes are based on alcohol-preserved specimens (three of which are comparatively recent), but no difficulty was experienced in separating this species, on colour alone, from *Barbus caudovittatus*. In the latter species the dark pigment is found on the distal half of the pectoral, pelvic and anal fins. The colour pattern is sometimes bleached out in specimens that have been badly preserved or have been preserved for a long time.

DISTRIBUTION. The specimens examined came from Lake Mweru, from between Kolwezi and Jadotville on the Lualaba, Upper Katanga, from Mwena, a tributary of the Lufira, Upper Katanga, from Gombela, Upper Katanga, from Kabiyaishi on

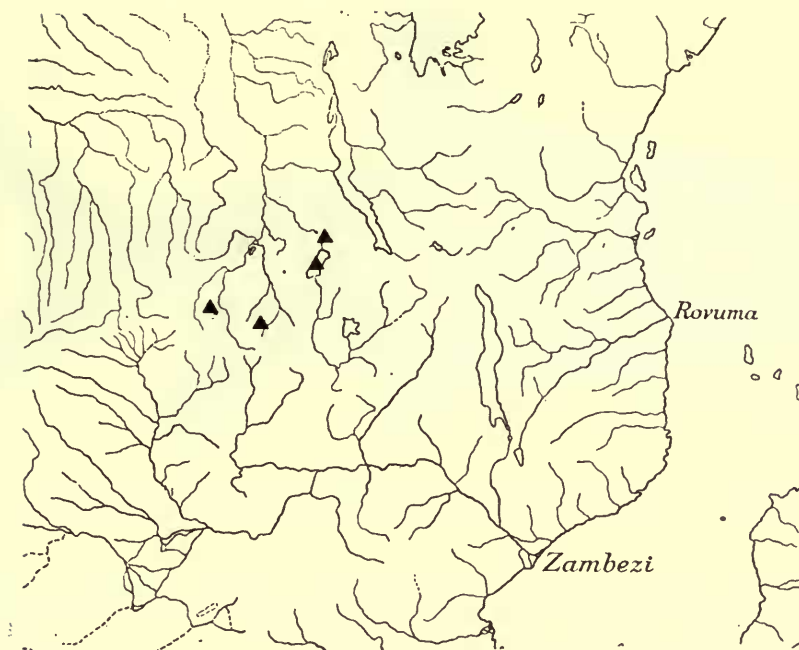


FIG. 101. A map of the distribution of *Barbus trachypterus*.

the Luanza, Upper Katanga, from Ngundeulu, Elizabethville (= Lubumbashi), and Kando, near Tenke, Upper Katanga.

AFFINITIES. The tubercles, the ventral mouth and the crowded pharyngeal teeth are reminiscent of the condition found in many species of the genus *Varicorhinus*. It is interesting to note that Poll (1948) thought that the relationships of *Varicorhinus bredoi* lay with *Varicorhinus stappersii* (here considered to be a synonym of *Barbus caudovittatus*) and *Varicorhinus brucei* (which was considered to be a variant of *Barbus marequensis* by Groenewald 1958). *Barbus trachypterus* specimens have often been confused with *Barbus caudovittatus* specimens but can be distinguished by the presence of a stronger dorsal spine and by a different colour pattern. Both *Barbus trachypterus* and *Barbus caudovittatus* have a ventral, curved mouth and possess a colour pattern unlike many of the east African species. The affinities of *Barbus trachypterus* could well lie with *Barbus caudovittatus* but much more needs to be known about the *Barbus* species of the southern and eastern parts of the Congo before a more informed conclusion can be drawn.

***Barbus tropidolepis* Boulenger 1900**

Barbus tropidolepis Blgr., 1900, *Annl. Mus. r. Congo Belge Zool.* **1**: 133, pl. xlix; Poll, 1953, *Result. scient. Explor. hydrobiol. Lac Tanganyika* **3** (5A): 74.
Varicorhinus chapini Nichols & LaMonte, 1950, *Proc. biol. Soc. Wash.* **63**: 175 (*vide* Poll, 1952, *Revue Zool. Bot. afr.* (46) **3-4**: 222).

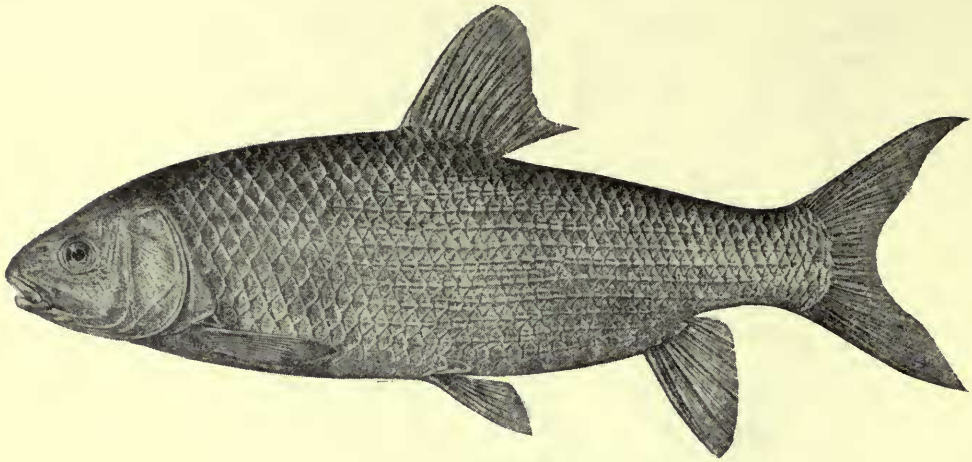


FIG. 102. *Barbus tropidolepis* 'Type' specimen (from Boulenger 1911a).

LECTOTYPE. Boulenger described this species from three fish from Usambura, Lake Tanganyika [B.M. (N.H.) Reg. Nos. 1906.9.6 : 19-21]. The smallest specimen, 239 mm S.L., is recognized as the lectotype.

DESCRIPTION. The description is based on 47 fish of 99 to 365 mm S.L. The morphometric data are expressed in tabular form below.

	\bar{x}	s.d.	s.e.	range
D	28.8	2.7	0.6	25.0-33.7
H	27.0	1.4	0.3	24.8-30.1
I	9.4	1.3	0.3	7.0-11.0
IO	9.0	1.5	0.3	7.4-11.4
MW	6.4	0.8	0.2	5.2- 8.8
Pct	20.8	1.0	0.2	19.1-23.9
CPl	14.9	1.2	0.3	12.9-17.7
CPd	11.7	0.9	0.2	10.1-13.7
Snt	8.4	1.0	0.2	5.2- 9.3

The eye is large and frequently protuberant. The characteristic body shape is shown in fig. 102. Although the anterior barbel is invariably absent and the posterior represented by no more than a small protrusion (as in many African *Varicorhinus* species) the mouth is no wider than in most *Barbus*. Worthington & Ricardo (1937) noted that the degree of lip development varies from continuous to discontinuous. A few specimens have thickened lips but in none of the fish examined were 'rubber lips' or '*Varicorhinus*-like' lips developed. The mouth is ventral under an obtuse snout.

Squamation. The lateral line has from 39 to 44 scales : 39 (f.2), 40 (f.9), 41 (f.11), 42 (f.13), 43 (f.9), 44 (f.3). There are 8.5 (rarely 7.5) scales between the dorsal midline and the lateral line and 8.5 (rarely 7.5, very rarely 9.5) between the lateral line

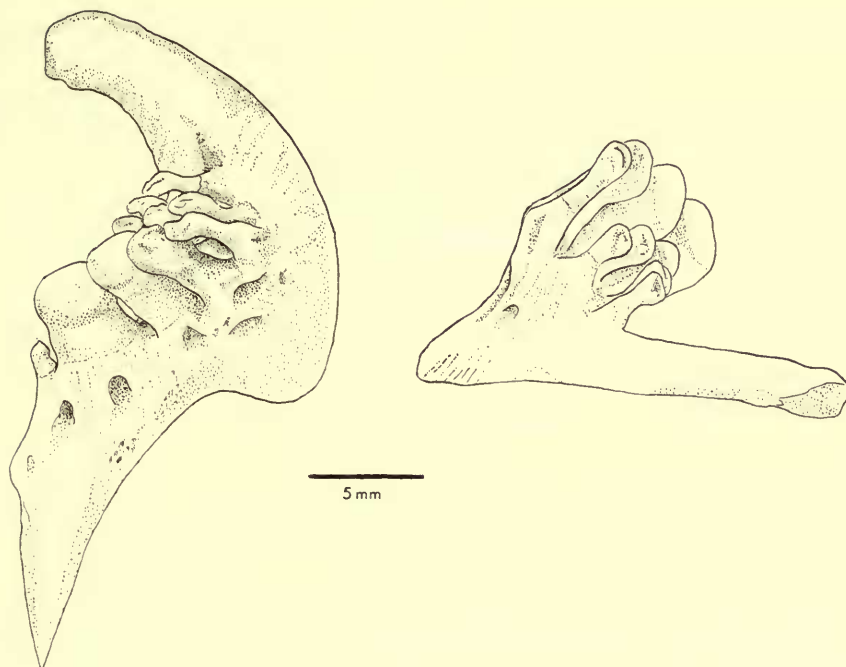


FIG. 103. The dorsal and lateral aspects of the right pharyngeal bone from *Barbus tropidolepis*.

and the ventral mid-line. Five and a half scale rows (rarely 4.5) lie between the lateral line and the pelvic fin base. Around the caudal peduncle are 16 (f.34), 17 (f.6) or 18 (f.7) scales. The most remarkable feature of the scales of *Barbus tropidolepis* is the presence of longitudinal folds of fat which form well-marked ridges on the body. These are most frequently found below the lateral line and from the middle to the posterior of the body. Not all specimens have them, e.g. B.M. (N.H.) Nos. 1936.6.15 : 596-598, fishes of 156 to 200 mm S.L. lack the ridges whilst they are present in other fish of less than 100 mm S.L.

Dorsal fin. It has four unbranched rays [not three as reported by Boulenger (1911a) and Worthington & Ricardo (1937)]. The last unbranched ray is ossified to form a smooth stout spine which varies in length from 20.8 to 30 per cent ($\bar{x} = 25.8$, s.d. = 2.7, s.e. = 0.6). There are nine (rarely 10) branched rays. The dorsal margin of the fin is frequently markedly concave with its posterior corner extended a little (see fig. 102). The dorsal fin origin is in advance of or above the origin of the pelvic fin.

The *anal fin* has three unbranched rays and five branched rays.

Pharyngeal bones and teeth. The pharyngeal teeth are molariform (fig. 103). The first tooth in the inner row is very small and in a few cases is absent although a small pinnacle of bone marks its site. The second tooth is large with a slightly

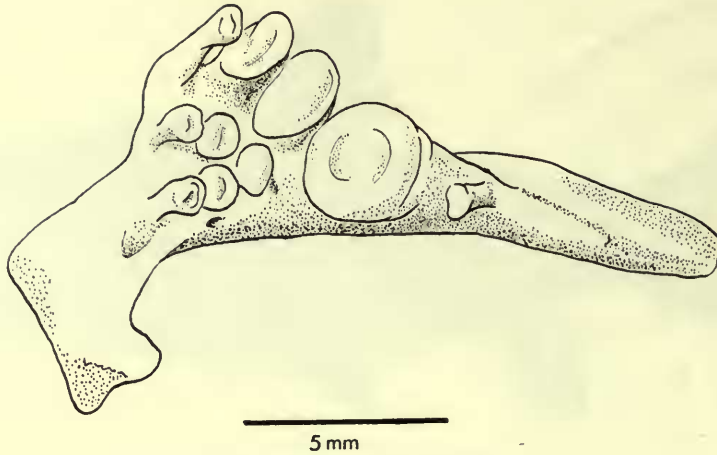


FIG. 104. The pharyngeal bone of *Barbus tropidolepis* positioned to show the alignment of the tooth rows.

concave crown. The third and fourth teeth are wider than they are long with concave posterior faces. The fifth tooth is conical and may be recurved. The alignment of the second and third rows is rather unusual in that the first tooth of the second row is slightly displaced dorsally so that both rows seem to radiate from that tooth. In the other species under consideration the second and third rows are distinct and parallel (*cf.* figs. 103 and 104). The pharyngeal teeth resemble those of *Barbus platyrhinus* (see p. 108).

Coloration. Brown or olive-brown above, lighter brown or silvery below in preserved fishes.

DISTRIBUTION. This species is endemic to the Lake Tanganyika basin. Poll (1953) gives a full list of the localities in this region where *Barbus tropidolepis* has been captured.

DIAGNOSIS AND AFFINITIES. *Barbus tropidolepis* appears to occupy a rather isolated position among East African *Barbus*; only *Barbus platyrhinus* has some features in common. The large number of scales, the development of ridges of fat on the scales and the shape of the pharyngeal teeth are indicative of the dissimilarities between this species and those of the neighbouring areas and it is clearly distinct from *Barbus caudovittatus*, the other large *Barbus* species in the lake.

It has certain features, in common with *Varicorhinus tanganicae*, viz. a high number of lateral line scales, a thick dorsal spine, large eyes and a similar snout. The phyletic significance of these similarities is doubtful. The number of pharyngeal teeth is the same but the alignment is different.

On the other hand, the unique specimen of *Varicorhinus chapini* is definitely a small *Barbus tropidolepis* with a slightly unusual mouth. The measurements of this small fish do not differ from equal-sized *Barbus tropidolepis* specimens.

DISCUSSION

Particularly noteworthy is the remarkable degree of variation in lip form, body shape and dorsal spine strength within some of the species described above (e.g. *Barbus altianalis* and *Barbus intermedius*).

These two species were represented by very large series of specimens (213 and 454 fishes respectively), so whether the same degree of variability would be shown by other species when equally large samples were studied or whether these two species are inherently more variable than the other described species cannot at the moment be determined. *Barbus bynni* (59 specimens) shows much less variation. The same is true of *Barbus oxyrhynchus*, which although more variable in body form than *Barbus bynni* (cf. the type of *Barbus labiatus*, fig. 78, with the type of *Barbus hindii*, fig. 79) does not approach the degree of variability shown by *Barbus intermedius*. *Barbus oxyrhynchus* is represented by 108 specimens, i.e. more than *Barbus bynni* and less than *Barbus altianalis* or *Barbus intermedius*. Without large series of specimens this matter cannot be taken further.

The intraspecific variation of the pharyngeal teeth is as large as the interspecific variation (excluding *Barbus tropidolepis* and *Barbus platyrhinus*, both of which have a very large degree of molarization of the pharyngeal teeth). It seems that the molarization of, particularly, the second tooth of the inner row is of no significance in establishing the identity of a specimen. The range in pharyngeal teeth shapes found in *Barbus intermedius* (figs. 56, 57 and 58) and *Barbus altianalis* (figs. 13 and 14) show this well. The seemingly random occurrence of a molariform second tooth in the inner row is shown by the series of pharyngeal bones of two of the subspecies of *Barbus altianalis* (figs. 13 and 14, also p. 20).

It was suggested above (p. 16) that the shape and strength of the pharyngeal bones and teeth might be influenced by the diet. The pharyngeal bones of *Barbus altianalis radcliffii* are stouter than those of *Barbus altianalis eduardianus*. Whether or not this is an effect of dietary differences could be checked comparatively easily by field studies.

It is known that water-snails are much less abundant in Lakes Edward and George than in Lake Victoria, and the differences between the pharyngeal teeth and bones of the populations of the cichlid *Astatoreochromis alluaudi* in these lakes has been associated with this fact. Greenwood (1964) has shown the differences in the stoutness of the pharyngeal teeth and bones to be phenotypic. Comparative data on the diets of the populations of *Barbus altianalis* in these lakes are lacking, but the striking similarity between the two phenomena is suggestive.

The presence of massive pharyngeal bones in large, deep-bodied specimens (p. 16) is possibly directly related to body depth. The 'surkis' form of *Barbus intermedius* has been shown to have been feeding on gastropod molluscs and the likelihood of the 'obesus' form of *Barbus altianalis radcliffii* also having gastropods as an important part of its diet has been mentioned above, although no identifiable remains were found in its alimentary tract. As only the deep-bodied examples of populations which consume gastropods display this phenomenon, it is more likely that the length of the pharyngeal bone is associated with the depth of the body as was noted on p. 16.

Wunder (1939) experimented on Common Carp (*Cyprinus carpio* L.) and observed that controlled feeding could produce a 'hunger' form and a 'fattened' form. The former resemble the 'gorguarii' form of *Barbus intermedius*, with a shallow body and a relatively long head. The fattened form resembled the 'surkis' form of *Barbus intermedius* (fig. 32) or the 'obesus' form of *Barbus altianalis* (fig. 3) in having a deep body, a relatively short head and stubby fins.

It is not possible to say whether greater body depth in a fish induces longer (but presumably not necessarily stouter) pharyngeal bones or whether extra food produces a deep-bodied fish in which the pharyngeal bone size relates to the kind and amount of food rather than to body depth. It has not yet been possible to determine the effect that a deeper body has on the depth of the head. It would be interesting to know if the 'gorguarii' and 'surkis' forms of *Barbus intermedius* represent poorly fed and well-fed populations. This could possibly be answered by field studies, but until that time one can do little but accept the various forms as different phenotypes or eco-phenotypes of variable species. It is important to note that the deep-bodied forms have so far only been found in lakes whilst most of the other body and lip forms occur throughout the range of the species. There is, regrettably, insufficient information available to comment further on the variation of these *Barbus* species.

As in the small *Barbus* with radiately striated scales described by Greenwood (1962), supra-specific complexes are discernible in the large *Barbus* described above. These complexes (see below) are difficult to define precisely since they are based on the rather amorphous (although useful) concept of general appearance. It must also be borne in mind that the species described here represent only a fraction of the total number of species of the large African *Barbus*. The extent and composition of the supra-specific assemblages will doubtless have to be re-evaluated when the phyletic interrelationships of the African *Barbus* are better understood.

Two complexes can be recognized amongst the species studied :

1) The *Barbus intermedius* complex. This comprises *Barbus intermedius*, *Barbus altianalis*, *Barbus acuticeps* and *Barbus ruasae* which inhabit most of the rivers of southern and eastern Ethiopia and northern Kenya, the Blue Nile system (including Lakes Rudolf and Baringo), the Lake Victoria basin and the lakes in the adjacent parts of the western rift valley. The lateral line scale counts range from 25 to 36 but are most frequently 28 to 32. Typically, the body is shallow, the caudal peduncle substantially longer than deep and the dorsal spine is smooth, strongly ossified and shorter than in the *Barbus bynni* complex (see below). The scales possess many parallel or slightly converging striae. At least two of the component species (*Barbus intermedius* and *Barbus altianalis*) are noteworthy for their high phenotypic variability. The species in this group show strong gross morphological resemblances to the *Barbus* of western and southern Saudi Arabia (e.g. *Barbus arabicus* Trewavas, 1939 and some as yet undescribed species from Aden) as well as to species like *Barbus batesii* Blgr. 1903 from South Cameroons. The significance of their distribution will be discussed below.

2) The *Barbus bynni* complex. This group contains *Barbus bynni*, *Barbus ganansensis*, *Barbus oxyrhynchus* and *Barbus longifilis* which inhabit the White and Albertine Niles, lakes at the fringe of the Blue Nile system (Abaya and Rudolf),

the eastern part of the Juba river, the Athi and Tana rivers and the Loama and Kanséhété rivers (upper Congo to the west of Lake Kivu). The lateral line scale count range is from 21 to 37, the most southerly species (*Barbus oxyrhynchus*) having a lower range than the rest, modally 24-25 against 31-33. The trend towards larger scales in southerly forms has been noted before by Greenwood (1962) for *Barbus paludinosus* and *Barbus kerstenii*. The scales have fewer striae than in the *Barbus intermedius* complex and the striae are more sinuous. The caudal peduncle is deeper in relation to its length than in the *Barbus intermedius* group and the dorsal spine is noticeably long and straight (p. 28). *Barbus oxyrhynchus* has one or two more branched rays in the dorsal fin than the other species in this group. *Barbus mariae* of the Athi river which is sympatric with *Barbus oxyrhynchus* does not seem to have much in common with the *bynni* complex, except a long dorsal spine and a similar lateral line scale count range.

One feature, the presence of small scales, is common to several lacustrine species: *Barbus tropidolepis*, *Barbus ethiopicus*, *Barbus platyrhinus* and *Barbus microterolepis* (see below). It is not suggested that these species are related, merely that the character has been acquired independently by the species that live in, and probably evolved in, lakes. Small-scaled, large *Barbus* species are not necessarily lacustrine though, as some of the fluviatile South African species (e.g. *Barbus polylepis*) show. It is possible that the modally higher lateral line scale count in *Barbus altianalis* amongst the *Barbus intermedius* complex is connected with its confinement in lake basins. However, its confinement in lake basins is not the same as the confinement in lakes of *Barbus tropidolepis* etc. There are populations of *Barbus altianalis radcliffii* which appear to be permanent inhabitants of the Kagera river (Dr P. H. Greenwood, pers. comm.). Superficially these fishes do not appear to differ from those in Lake Victoria, but no detailed investigations have been carried out. The lacustrine *Barbus altianalis radcliffii* do not spend all their time in the lake, they display their fluviatile ancestry by ascending rivers to breed (Whitehead 1959).

Barbus tropidolepis, it should be noted, also ascends rivers to breed (Poll 1953) but does not apparently live in rivers outside of the breeding season. Nothing is known about the habits of *Barbus ethiopicus*, *Barbus platyrhinus*, nor *Barbus microterolepis*.

In this context there are some ideas of Farquharson (1962) that must be considered. He discussed the distribution in South Africa of the small-scaled *Barbus* species (e.g. *Barbus natalensis*, *Barbus holubi*, *Barbus capensis* and *Barbus kimberleyensis*) with parallel scale striations. From their widespread distribution and endemism he suggested that an ancient dispersion is indicated. If this is so, then it is possible that the small-scaled lacustrine species mentioned above are relicts of this dispersion southwards (see above). I have not been able to compare specimens of the small-scaled South African species with the small-scaled species from Lakes Tanganyika and Zwai.

Farquharson (*ibid.*: 247) discusses the influence of water temperature on scale number and lists a series of *Barbus* species arranged in order of localities from 'hot' to 'cold' showing the increase in the number of lateral line scales. Regrettably, the situation is not as simple as this as, for example, the review by Tåning (1952)

shows. There may be some basic truth in Farquharson's idea but at the moment there is insufficient data to put forward a general case.

It is suggested here that *Barbus altianalis* came from the same stock as *Barbus intermedius* and that the smaller scales developed after it was confined to the lake basins, subsequent to the rift valley formation (see p. 22). *Barbus microterolepis* could also have been derived from *Barbus intermedius* in this fashion (assuming that it is a good species and not a hybrid or genetical abnormality – see p. 91).

No other supra-specific groups are recognizable among the species described. The affinities of *Barbus stappersii* would seem to be with the Zambezi species *Barbus marequensis*. *Barbus caudovittatus* is probably associated with Congo species and hence outside the scope of this paper. Too few specimens of some of the other species are available to be able to evaluate their characters, but a revision of the Congo *Barbus* may give some indications of their relationships.

The problematical relationships of *Barbus macrolepis* may not be solved until the *Barbus* species of West Africa are revised. The remarkable similarity of this species to *Barbus lagensis* from Nigeria is noted above (p. 83).

Barbus somereni and *Barbus mirabilis* do not seem to be related to any of the other species described in this paper. Again, a study of the Congo fauna may reveal species related to these two.

It is, perhaps, interesting to compare the distribution of the small *Barbus* species with radiately striated scales with that of the large *Barbus* species described above. The small *Barbus* species are widely distributed and several species are found in widely separated river systems. By contrast the most widespread of the large *Barbus* species described in this paper are found in palaeogeographically closely related and/or adjacent river systems. Presumably the small *Barbus* species are able to travel from one river system to another via the swamps which frequently form the watersheds. Bell-Cröss (1965) noted that the only *Barbus* species living in the watershed on the Muhinga plain which separates the Congo from the Zambezi system are small, 'radiately striated' species. The large *Barbus* species would seem to be less successful at negotiating the small streams, seasonal ponds and swamps at the headwaters of the river systems. Their larger size must be a contributing factor, certainly none have been found at the extremities of river systems. Bell-Cross (1960) suggested that the reason why some fishes did not cross watersheds was not necessarily because of their physical inability to do so but because of some other factor like behavioural inhibitions. Regrettably there have been very few observations on this problem. Darlington (1957: 78–80), however, argues that given enough time primary fresh-water fishes (e.g. Ostariophysi) can overcome almost any physical barriers limiting their range. Perhaps the time scale involved is not large enough to be applicable to the large *Barbus* species in this context.

If the habitats of the large *Barbus* species are likely to be isolated, the possibility exists that the relationships of various species might prove useful as indicators of the relationship of river systems and vice versa.

If the rate of phenotypic change is less than the time taken for rivers to be dissociated then it is feasible to think that the now-separated populations of fishes would be detectable as members of the same taxon. The general principle of this

idea is borne out in certain instances, e.g. between *Barbus altianalis* and *Barbus intermedius*, between *Barbus somereni* and *Barbus mirabilis* and between the members of the *Barbus bynni* complex. The geographical evidence for this idea in the *Barbus bynni* complex is lacking in detail, but there is nothing geographically inconsistent in the former association of their river systems (see p. 22).

Günther (1869), writing on the Nile fishes collected by Petherick, noted that the upper Nile fauna is related more closely to that of the Palestinian and West African rivers than to the fauna of Lake Nyasa (Malawi) and the Zambezi river. By 1880 Günther had expanded the horizons of the affinities of the African fresh-water fish fauna. He thought that as some families had more representatives in India than in Africa they probably originated in India or derived from an Indian stock. He also considered the fauna of Jordan and Syria to have so many African representatives that he included them in the African region as well as in his Euro-Asiatic region.

Gregory (1896) reviewed the evidence for the faunal similarities between the Nile and Jordan rivers and concluded that the Jordan river has species in common with the upper, but not with the lower Nile. Because of this, he conjectured that in the past a river flowed from Lakes Albert and Victoria, which then had no outlet to the Nile, into Lake Rudolf and then via the Omo and Hawash rivers across the Afar depression into the Red Sea. The Red Sea trough would, he thought, at that time have been filled with fresh water and with an extension of the Jordan river flowing into it.

Nichols & Griscom (1917), with a great many more species at their disposal than were available to Gregory, divided the fish fauna of Africa into six regions and commented on the relationships of one faunal area to another. It is probably significant that the boundary line between their 'Nile and North East Africa' region and their 'East African' region follows closely the boundary between the ranges of *Barbus intermedius* and *Barbus oxyrhynchus*. The fish of North West Africa, they noted, have affinities with the European fishes. The fauna of the 'Nile and North East Africa' region had affinities both with the West tropical Africa region (Nichols and Griscom postulate extensive contact in the past between the Nile and the Congo) and northern or Asiatic forms. The fauna (particularly the Cyprinidae) of the Nile and North East Africa region '... seem invariably to have entered Africa from the north-east. They predominate in the Nile basin and East Africa, reaching South Africa but are much more poorly represented in West Africa.'

Menon (1964) in his revision of the cyprinid genus *Garra* decided that the African *Garra* species came into Africa in a series of waves, each succeeding wave dispersing the forms that came in the preceding wave. His postulated routes for this were either via the Sinai peninsula or via Saudi Arabia and Somaliland before these two countries were separated by the Red Sea. The evidence for this is somewhat sparse, the idea being based on the general pattern of the distribution of cyprinids in Asia and the pattern of distribution of fishes in Africa with the most archaic forms in the west (Darlington 1957 : 60).

There exist in south-western Saudi Arabia and Aden some *Barbus* species (*Barbus arabicus* Trewavas 1939 – and some undescribed species) which would fit in well with the *Barbus intermedius* supra-specific complex. The question that cannot yet

be answered is whether the Arabian species represent relict populations of the migration of the *Barbus intermedius* ancestral stock into Africa or whether they represent a radiation from Ethiopia into Arabia. In either case the increase in the salinity of the Red Sea (possibly during the Pliocene – see below) severed contact between the two groups.

The geological history of the Red Sea is not known in great detail, but enough is known to enable a brief history to be constructed. Dubetret (1970) considers the Red Sea cut across the Precambrian rocks forming the African and Arabian shield. Up to the Miocene it seems that marine incursions along the incipient Red Sea trench were confined to the northern end (north of Quasir 27°5' N) where upper Cretaceous marine deposits are found. The Neogene history is better known.

Dubetret (*op. cit.*) dates the Red Sea from the Miocene. Foundering from the Lower Miocene resulted in the Mediterranean Sea flowing into the Gulf of Suez to approximately the southern end of the Red Sea. A land barrier existed at the south separating the Mediterranean water from the Indian Ocean water. During the late Miocene and Pliocene an upward earth movement in the Gulf of Suez area cut off the Red Sea from the Mediterranean.

In the Pliocene the southern land barrier sank and allowed Indian Ocean water to flow into the inland sea. The northern land barrier prevented any contact with the Mediterranean.

Botros (1971) thinks that a series of fresh-water lakes was present in the southern part of the Red Sea trench during the Oligocene and late Eocene, whilst the northern end was an arm of the Mediterranean Sea. He is also of the opinion that it was possible for the land bridge across the southern end of the Red Sea to have become apparent again during the Pleistocene as a result of the lowering of the sea level during the Ice Ages.

It seems then that what is now Arabia (Roberts 1970 : fig. 2) did not separate from the horn of Africa until the end of the Miocene or early Pliocene and that the two land masses may have been in contact again during the Pleistocene. It can therefore be surmised that there was enough contact over a long period of time for Asiatic cyprinids to have migrated into Africa or vice versa.

The pattern of distribution of the supra-specific complexes defined above (fig. 105) refines the problem but does not solve it. The geographically most compact supra-specific complex (the *Barbus intermedius* complex) is in northeast Africa (and it is suggested, in Saudi Arabia). This is ringed to the west and south by the rather more fragmented and scattered members of the *Barbus bynni* supra-specific complex. Still more scattered are the localities for *Barbus somereni* and *Barbus mirabilis*. This distribution could be interpreted as the result of a series of invasions from the northeast. *Barbus lagensis* and *Barbus macrolepis*, if they are as closely related as the available evidence suggests, could represent the remnants of an early scattering of species caused by these invasions (see p. 83).

The reasons for this apparent effect are unknown, but it could be related to the formation of topographical changes in the Ethiopian highlands. The tectonic movements must have had a profound effect in altering the courses of rivers, linking some and separating others. This could have happened more than once and over a

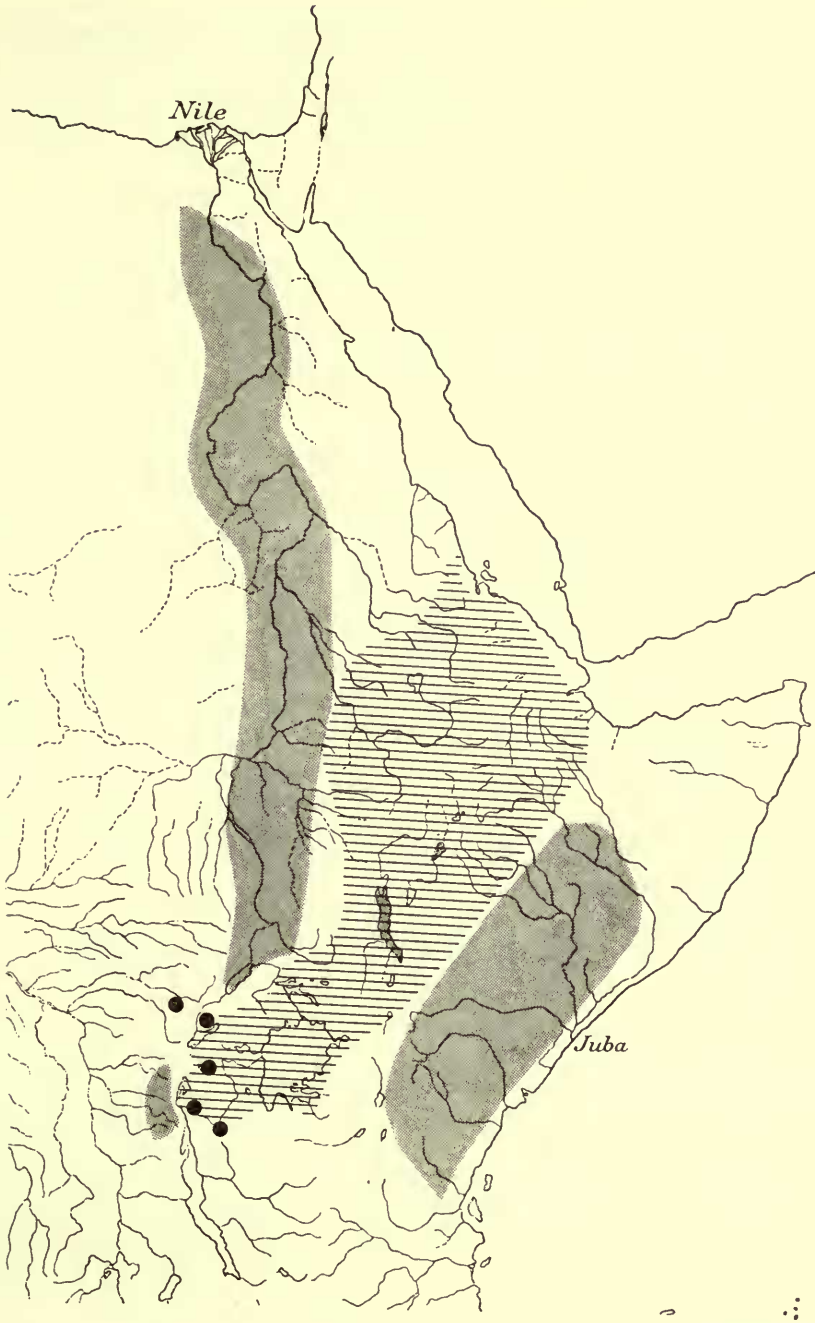


FIG. 105. A map of the distribution of A) the *Barbus intermedius* supraspecific complex (hatched area), B) the *B. bynni* supraspecific complex (dark area), C) *B. somereni* and *B. mirabilis* (solid circles).

long period of time, which could ultimately cause speciation within a previously uniform population. Unfortunately the geological history of this region is poorly known. Migration west and south would scatter the daughter species. Any subsequent waves of immigration in this region might hence be subject to the same kinds of isolation as the earlier waves and further supra-specific complexes would result.

There is evidence to suggest that fishes have been able to move from northeast Africa into the middle east. The presence of *Tilapia* species in Jordan is an example of this. The only conclusions that can be drawn about the large *Barbus* species is that they were at some stage able to move between the horn of Africa and Saudi Arabia. It would need fossil evidence to show in which direction the movement took place. Brown (1970) reports the presence of *Barbus* species and *Tilapia* species in the late Oligocene or Miocene of Jizan (Saudi Arabia, just north of the Yemen border).

The large *Barbus* species of Africa are, as a group, quite distinct from the majority of species living in the Tigris and Euphrates rivers (the nearest region with a good cyprinid fauna). The Tigris and Euphrates species mostly resemble *Barbus barbatus* L. of Europe in possessing relatively small scales and a serrated dorsal spine. Of the smooth dorsal spined species from Syria, *Barbus canis* C. & V. (*Tor canis* of Karaman 1971) most closely resembles the African species, especially the *Barbus intermedius* complex. An isolated population of *Barbus canis* from Khamis Mushyat (18°17' N, 42°34' E – about 400 km southeast of Jeddah, Saudi Arabia) is the population closest to the African continent. The members of this population are less like the African *Barbus* species than are the Syrian populations as they lack the anterior pair of barbels. The fish fauna of Saudi Arabia is sparse and too poorly collected for opinions to be formed on whether the absence of the anterior barbels in the Khamish Mushyat population is a local phenomenon or part of a clinal phenomenon. The *Barbus* species of Aden are, as has been mentioned above, extremely similar to *Barbus intermedius*.

The presence of *Barbus* species in Saudi Arabia which closely resemble some of the African species presents two possibilities about the origin of the African representatives.

Firstly, did the *Barbus* species now typical of Africa evolve in Africa from dissimilar ancestors of which now no trace remains? If so, then the Arabian and Syrian smooth-spined *Barbus* species could represent the relicts of a migration from Africa. The centre of this particular radiation could well have been in Ethiopia as the African and Arabian land masses must have been in contact. Therefore the status of the Arabian and Syrian species would be the same as *Barbus altianalis* and *Barbus ruandae*, i.e. the members of the *Barbus intermedius* supra-specific complex.

The other possibility is that the facies characteristic of the African *Barbus* species were to some extent present in the ancestral stock. If this were so, and if the ancestral stock was not originally African, could the Arabian and Syrian species of the *Barbus canis* type represent remnants of the ancestral stock?

Not enough is known at the moment to be able to decide which of these two possibilities (if either) represents the truth and it is quite possible that the notion of

a series of migrations all in the same direction is far too simple. The ideas in the previous two paragraphs refer only to the putative last migration that produced the species forming the *Barbus intermedius* supra-specific complex. Of the even earlier migrations and scatterings conjectured from the distribution of the extant species there is no trace, but this does not affect the equally likely (on available evidence) alternative ideas on the relationship of the *Barbus intermedius* complex to the relevant *Barbus* species of Saudi Arabia and Syria.

However, no firm conclusions can be drawn until the fossil record and the phylogeny of this group of *Barbus* species are better known. For a full understanding of the phylogeny and distribution of the African *Barbus* species, the relationship of the small 'radiately striated' *Barbus* species to the large *Barbus* species must be determined as well as the relationships of the African *Barbus* species *sensu lato* to the *Barbus* species of Europe and the Near East. The distributional problems relate principally to the role of the closely related cyprinid genera, i.e. why should there be a relative paucity of large *Barbus* species in west Africa but a comparative abundance of *Varicorhinus* species and *Labeo* species? The reverse situation exists in the east. In all probability the solutions to these problems lie as much in the sphere of the field worker as in the sphere of the museum worker.

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REFERENCES

- ALEXANDER, R. McN. 1966. The function and mechanisms of the protrusible upper jaws of two species of cyprinid fish. *J. Zool., Lond.* **149**: 288-296.

- AMIRTHALINGHAM, C. & YASSAA KHALIFA, M. 1965. *A Guide to the Common Commercial Fresh Water Fishes in the Sudan*. Game and Fisheries Dept., Republic of Sudan.
- BAILEY, R. G. 1969. The non-cichlid fishes of the eastward flowing rivers of Tanzania, East Africa. *Revue Zool. Bot. afr.* **30** (1-2) : 171-199.
- BANISTER, K. E. 1972. On the cyprinid fish *Barbus alluaudi* Pellegrin ; a possible intergeneric hybrid from Africa. *Bull. Br. Mus. nat. Hist. (Zool.)* **24** (5) : 261-290.
- BELL-CROSS, G. 1960. Observations on the movements of fish in a fish ladder in Northern Rhodesia. *Third Symposium on Hydrobiology and Inland Fisheries Problems of Major Lakes*. C.S.A./C.C.T.A. Publication No. 63 : 113-125.
- 1965. Movement of fish across the Congo-Zambesi watershed in the Mwinilunga district of Northern Rhodesia. *Proc. Cent. Afr. Sci. Med. Congr.* : 415-424.
- BINI, G. 1940. I pesci del Lago Tana. *Missione Stud. Lago Tana* **3** (2) : 138-206.
- BISHOP, W. W. 1963. The later Tertiary and Pleistocene in eastern equatorial Africa. In : *African Ecology and Human Evolution* : 246-275, eds Howell, F. C. and Boulière, C. Werner Gren Foundation, New York.
- 1969. Pleistocene stratigraphy in Uganda. *Mem. geol. Surv. Uganda* **10**.
- 1971. The later cenozoic history of East Africa in relation to Hominid evolution. In : *The Late Cenozoic Glacial Ages* : 493-527, ed Turkenan, K. L. Yale University.
- BOTROS, G. A. 1971. Fishes of the Red Sea. In : *Oceanogr. Mar. Biol. Ann. Rev.*, ed. Barnes, H. **9** : 221-348. George Allen & Unwin Ltd, London.
- BOULENGER, G. A. 1907. *Zoology of Egypt : the Fishes of the Nile*. Pub. for the Egyptian Government by Hugh Rees, London.
- 1911a. *Catalogue of the Fresh-water Fishes of Africa in the British Museum (Natural History)*, **2**. London.
- 1911b. Descriptions of two new African barbels. *Ann. mag. nat. Hist.* (8) **8** : 369-370.
- 1916. *Catalogue of the Fresh-water Fishes of Africa in the British Museum (Natural History)*, **4**. London.
- BROWN, G. F. 1970. Eastern margins of the Red Sea and the coastal structures in Saudi Arabia. In : A discussion on the structure and evolution of the Red Sea, Gulf of Aden and Ethiopian rift junction, organised by FALCON, N. L. *et alii*. *Phil. Trans. Roy. Soc. Lond. A* **267** : 75-89.
- BROWN, J. M. 1956. Geophysics. In : Harris, N., *et alii*. Oil in Uganda. *Mem. geol. Surv. Uganda*, **9**.
- CAHEN, J. 1954. *Géologie du Congo Belge*, Liège.
- COOKE, H. B. S. 1958. Observations relating to the quaternary environment in east and southern Africa. 73 pp. DuToit Memorial Lecture No. 5. *Geol. Soc. S. Africa Annex*. 60.
- COPLEY, H. 1948. *Lakes and Rivers of Kenya*. Longman Green & Co. Nairobi.
- 1958. *Common Freshwater Fishes of East Africa*. Witherby, London.
- CRASS, R. S. 1960. Notes on the freshwater fishes of Natal with descriptions of four new species. *Ann. Natal Mus.* **14** (3) : 405-458.
- DARLINGTON, P. J., JR. 1957. *Zoogeography : the Geographical Distribution of Animals*. John Wiley & Sons Inc., New York.
- DAVID, L. 1936. Contribution à l'étude de la faune ichthyologique du Lac Tanganika. *Revue Zool. Bot. afr.* **23** (2) : 149-160.
- 1937. Poissons de l'Urundie. *Revue Zool. Bot. afr.* **29** (4) : 413-420.
- & POLL, M. 1937. Contribution à la faune ichthyologique du Congo Belge. *Annls Mus. r. Congo Belge* (1) **3** (5) : 193-292.
- DE HEINZELIN, J. 1955. Le fossé tectonique sous le parallèle d'Ishango. *Explor. Parc natn. Albert Miss. J. de Heinzelin de Braucourt* **1**.
- DONALDSON-SMITH, A. C. 1897. *Through Unknown African Countries*. Edward Arnold, London and New York.
- DOORNKAMP, J. C. & TEMPLE, P. H. 1966. Surface, drainage and tectonic instability in part of southern Uganda. *Geogr. J.* **132** (2) : 238-252.

- DUBERTRET, L. 1970. Review of the structural geology of the Red Sea and surrounding areas. In: A discussion on the structure and evolution of the Red Sea, Gulf of Aden and Ethiopian rift junction, organised by FALCON, N. L. *et alii*. *Phil. Trans. Roy. Soc. Lond.* **A 267** : 9-20.
- FARQUHARSON, F. L. 1962. The distribution of cyprinids in South Africa. *Ann. Cape prov. Mus.* **2** : 233-251.
- FISCHER, J. G. 1884. Über einige afrikanische Reptilien, Amphibien und Fische des Naturhistorischen Museums. *Jb. hamb. wiss. Anst.* **1** : 3-39.
- FOWLER, H. W. 1930. Fishes obtained by the Gray African Expedition 1929 with notes on other species in the Academy Collection. *Proc. Acad. nat. Sci. Philad.* **72** : 27-83.
- 1936. Zoological results of the George Vanderbilt African Expedition of 1934. Part III, The freshwater fishes. *Proc. Acad. nat. Sci. Philad.* **78** : 243-335.
- FRYER, G. 1968. The parasitic Crustacea of African freshwater fishes; their biology and distribution. *J. Zool. Lond.* **156** : 45-95.
- GREENWOOD, P. H. 1959. Quaternary fish fossils. *Explor. Parc natn. Miss. J. de Heinzelin de Braucourt* **4** (1) : 1-80.
- 1962. A revision of certain *Barbus* (Pisces, Cyprinidae) from East, Central and South Africa. *Bull. Br. Mus. nat. Hist. (Zool.)* **8** (4) : 151-208.
- 1964. Environmental effects on the pharyngeal mill of a cichlid fish *Astatoreochromis alluaudi*, and their taxonomic implications. *Proc. Linn. Soc. Lond.*, **176** (1) : 1-10.
- 1966. *The Fishes of Uganda*. 2nd ed. The Uganda Society, Kampala.
- GREGORY, J. W. 1896. *The Great Rift Valley, being a Narrative of a Journey to Mount Kenya and Lake Baringo*. John Murray, London.
- GROENEWALD, A. A. v. J. 1958. A revision of the genera *Barbus* and *Varicorhinus* (Pisces, Cyprinidae) in Transvaal. *Ann. Transv. Mus.* **23** (3) : 263-330.
- GÜNTHER, A. C. 1869. The fish of the Nile. In: PETHERICK, J. & PETHERICK, B. H., *Travels in central Africa* **2** : 197-268. Tinsley Bros., London.
- 1880. *An Introduction to the Study of Fishes*. Adam & Charles Black, Edinburgh.
- 1894. Report on the collection of reptiles and fishes made by Dr J. W. Gregory during his expedition to Mount Kenya. *Proc. zool. Soc. Lond.* : 84-91.
- 1896. Report on a collection of fishes made by Dr A. Donaldson-Smith during his expedition to Lake Rudolf. *Proc. zool. Soc. Lond.* : 217-224.
- HOLLY, M. 1929. Einige neue afrikanische Fishformen. *Anz. Akad. Wiss. Wien* **66** : 32-35.
- JACKSON, P. B. N. 1961. *The Fishes of Northern Rhodesia*. Government Printer, Lusaka.
- JUBB, R. A. 1961. *An Illustrated Guide to the Freshwater Fishes of the Zambesi River, Lake Kariba, Pungwe, Sabi, Lundi and Limpopo Rivers*. Stuart Manning, Bulawayo.
- 1963. A revised list of the freshwater fishes of Southern Africa. *Ann. Cape prov. Mus.*, **3** : 5-39.
- 1965. Freshwater fishes of Cape Province. *Ann. Cape prov. Mus.* **4** : 1-72.
- 1967a. *Freshwater Fishes of South Africa*. A. A. Balkema, Cape Town.
- 1967b. Notes on the popular angling yellow fishes and distribution outside their native range. *Piscator* **20** : 120-125.
- 1968. The *Barbus* and *Varicorhinus* species (Pisces: Cyprinidae) of Transvaal. *Ann. Transv. Mus.* **26** (4) : 79-97.
- KARAMAN, M. L. 1971. Süßwasserfische der Türkei. 8. Revision der Barben Europas, Vorderasiens und Nordafrikas. *Mitt. hamburg. zool. Mus. Inst.* **67** : 175-254.
- KENDALL, R. L. 1969. An ecological history of the Lake Victoria basin. *Ecol. Monogr.* **39** (2) : 121-176.
- KLAUSEWITZ, W. & NIELSEN, J. G. 1965. On Forskål's collection of fishes in the zoological museum of Copenhagen. *Spolia zool. Mus. haun.* **22** : 1-31.
- LADIGES, W., VON WAHLERT, G. & MOHR, E. 1958. Die Typen und Typoide der Fischesammlung des Hamburgischen Zoologischen Staatsinstitut und Zoologischen Museums. *Mitt. hamburg. zool. Mus. Inst.* **56** : 155-167.

- MANN, M. J. 1971. Some taxonomical notes on the fish fauna of the Baringo area. *Afr. J. Trop. Hydrobiol. Fish.* **1** (1) : 25-34.
- MARLIER, G. 1953. Etude biogéographique du bassin de la Ruzizi basée sur la distribution des poissons. *Annl. Soc. r. zool. Belg.* (1) **84** : 175-224.
- MATHES, H. 1962. Poissons nouveaux ou intéressants du Lac Tanganika et du Ruanda. *Annl. Mus. r. Afr. cent. Sér 8°* **111** : 81.
- MAYR, E. 1949. *Systematics and the Origin of Species*. Columbia Biological Series No. 13. New York.
- MENON, A. G. K. 1964. Monograph of the Cyprinid fishes of the genus *Garra*, Hamilton. *Mem. Indian Mus.* **14** (4) : 173-260.
- NICHOLS, J. T. & GRISCOM, L. 1917. Fresh-water fishes of the Congo basin obtained by the American Museum Congo Expedition, 1909-1915. *Bull. Am. Mus. nat. Hist.* **37** (25) : 653-756.
- NORMAN, J. R. 1925. A new siluroid fish of the genus *Clarias* from South-western Uganda. *Occ. Pap. Boston Soc. nat. Hist.* **5** : 189-190.
- PAPPENHEIM, P. & BOULENGER, G. A. 1914. Fische. *Wiss. Ergebn. dt. ZentAfr. Exped. Zool.* (5) Zoologie **3** : 225-260.
- PARENZAN, P. 1939. I pesci del bacino del Lago Regina Margherita nel Galla e Sidama. *Boll. Pesca Piscic. Idrobiol.* **15** : 146-173.
- PEEL, C. V. A. 1900. *Somaliland*. Robinson & Co., Gt Russel St, London.
- PELLEGRIN, J. 1933. Poissons de la région du Kivu adressés par M. Guy Babault. *Bull. Soc. zool. Fr.* **58** : 169-175.
- 1935. Poissons de la région du Kivu récoltés par M. Guy Babault. *Revue Zool. Bot. afr.* **27** (3) : 376-385.
- PFEFFER, G. 1889. Uebersicht der von Herrn Dr Stuhlmann in Aegypten, auf Zanzibar und dem gegenüberliegenden Festlande gessammelten Reptilien, Amphibien, Fische, Mollusken und Krebse. *Jb. Hamb. wiss. Anst.* **6** (2) : 1-36.
- POLL, M. 1939. Poissons. *Explor. Parc natn. Albert Miss G. F. de Witte* **24** : 1-81.
- 1946. Revision de la faune ichthyologique du Lac Tanganika. *Annl. Mus. r. Congo Belge. Zool.* (1) **4** (3) : 141-364.
- 1948. Poissons recueillis au Katanga par H. J. Bredo. *Bull. Mus. r. Hist. nat. Belg.* **24** (21) : 1-24.
- 1953. Lac Tanganika (poissons non Cichlidae). *Résult. scient. Explor. hydrobiol. Lac Tanganika* **3** (5A) : 1-251.
- 1967. Contribution à la faune ichthyologique de l'Angola. *Publções cult. Co. Diam. Angola* **75** : 1-381.
- ROBERTS, D. G. 1970. A discussion mainly concerning the contributions by Hutchinson and by Baker. In: A discussion on the structure and evolution of the Red Sea, Gulf of Aden and Ethiopian rift junction, organised by FALCON, N. L. *et alii*. *Phil. Trans. Roy. Soc. Lond.* **A 267** : 399-407.
- RÜPPELL, E. 1837. Neuer Nachtrag von Beschreibungen und Abbildungen neuer Fische, im Nil Entdeckt. *Mus. senckenb.* **2** : 5-10.
- SANDON, H. 1950. *An Illustrated Guide to the Freshwater Fishes of Sudan*. Sudan Notes Rec. Khartoum.
- STUVIER, M., DEEVEY, E. S. & GRALENSKY, L. J. 1960. Yale natural radiocarbon measurements. *Radiocarbon* **2** : 56.
- TÅNING, Å. V. 1952. Experimental study of meristic characters in fishes. *Biol. Rev.* **27** : 169-193.
- TEMPLE, P. H. 1969. Some biological implications of a revised geological history for Lake Victoria. *Biol. J. Linn. Soc.* **1** (4) : 363-373.
- VINCIGUERRA, D. 1898. I pesci dell'ultima spedizione del Cap. Bottego. *Annali Mus. civ. Stor. Natn. Giacomo Doria* (2) **19** : 240-261.
- WHITEHEAD, P. J. P. 1959. The anadromous fishes of Lake Victoria. *Revue Zool. Bot. Afr.* **59** (3-4) : 329-363.

- WORTHINGTON, E. B. 1932a. Scientific results of the Cambridge Expedition to the East African Lakes. 1930-1931. 2. Fishes other than Cichlidae. *J. Linn. Soc. zool.* **38**: 121-134.
 — 1932b. The Lakes of Kenya and Uganda. *Geogr. J.* **79** (4): 275-297.
 — & RICARDO, C. K. 1937. The fish of Lake Tanganyika (other than Cichlidae). *Proc. zool. Soc. Lond.* (4): 1061-1112.
 WORTHINGTON, S. & E. B. 1933. *The Inland Waters of Africa*. MacMillan & Co. Ltd, London.
 WUNDER, W. 1939. Die 'hungerform' und die 'mastform' des Karpfens (*Cyprinus carpio* L.). *Z. Morph. Okol. Tiere* **35** (4): 594-614.
 ZOLEZZI, G. 1939. Descrizione di tre nuovi Ciprinidi raccolti dalla Missione Ittologica in A.O.I. *Boll. Pesca Piscicolt. Idrobiol. Roma* **15**: 369.

APPENDIX I

An artificial key to the *Barbus* species described in this paper

1. LI : > 46
 Lake Zwai basin *B. ethiopicus*
2. LI : 38-44
 a) No anterior barbel; posterior barbel minute; ridges of fat on scales of adults
 L. Tanganyika basin *B. tropidolepis*
- b) Anterior barbel present
 i) IO more than 8 per cent S.L.; heavy-bodied, bulky appearance; pharyngeal bones short and thick, pharyngeal teeth molariform
 L. Tanganyika basin *B. platyrhinus*
- ii) IO less than 8 per cent S.L.; compressed, slender body; pharyngeal teeth thin and hooked
 L. Zwai basin *B. microterolepis*
3. LI : < 38
 a) Last unbranched dorsal fin ray weak and flexible with persistent articulations
 i) CPI > CPd; body shallow; L₂₄₋₃₀ (most often 26-28), striae on scales parallel
 L. Tanganyika basin and upper reaches of Congo *B. caudovittatus*
- ii) CPI = CPd; body deep; scales with few converging striae (fig. 64)
 Lower Malagarasi and Tanzanian coastal rivers *B. macrolepis*
- b) Last unbranched dorsal fin ray ossified without articulations, at least in basal half
 i) Body typically deep; CPI = CPd
 † Dorsal spine thin, only ossified basally
 L. Mweru region *B. stappersii*
- †† Dorsal spine long, thick and strong *B. bynni* complex
 (except in *B. pagenstecheri*) (see below)
- ii) Body typically shallow; CPI > CPd
 † Dorsal spine massive, long; upper jaw curves down to cover the lower jaw laterally giving a 'clupeoid' appearance to the mouth ††
 Athi-Tana system *B. mariae*
- †† Dorsal spine not as above
 ‡ mouth ventral ††
 □ straight edge to square LJ; □□
 very small barbels
 Rwanda *B. microbarbis*

- mouth semicircular
 * Dark pigment of distal portions of pectoral, pelvic and anal fins
 Upper Congo, W. of L. Kivu *B. paucisquamatus*
 ** Dark pigment on proximal parts of pectoral, pelvic and anal fins
 L. Mweru region *B. trachypterus*
 ‡‡ mouth not as above
 ■ striae on scales vary with position of scale on body, typically striae more radiate on belly than on back; DIV-9 or 10
 ○ Bulky body (fig. 74)
 West of rift valley *B. mirabilis*
 ○○ Body not bulky
 Ruwenzori mountains and upper Malagarasi *B. somereni*
 ■■ striae ± parallel and sinuous, no great variation in pattern with position on body; DIV-8 or 9
B. intermedius
 complex (see below)

Barbus bynni complex

- 1) DSP, \bar{x} = 30.0, spine strong 2)
 Nile, L. Albert, L. Abaya, L. Rudolf *B. bynni*
 2) DSP, \bar{x} = 25.0-30.0, strong 3)
 a) Ab, \bar{x} = 9 (range 8-10); Pb, \bar{x} = 11 (range 9-12).
 Pct 21-24
 Congo W. of L. Kivu *B. longifilis*
 b) Ab, \bar{x} = 6 (range 3-10); Pb \bar{x} = 7 (range 3-12).
 Pct 22-28, \bar{x} = 24.4
 Athi and Tanā systems *B. oxyrhynchus*
 3) DSP 25.0 or less, but weaker than above
 Juba river *B. gananensis*
 4) DSP 20.0 or less, shallow body
 Kilimanjaro region *B. pagenstecheri*

Barbus intermedius complex

- 1) Dorsal profile of head concave; mouth opens antero-dorsally; nuchal hump present
 LI 27-30; DSP, \bar{x} = 22.3
 Rwanda and Burundi *B. acuticeps*
 2) Dorsal profile of head not concave, mouth sub-terminal or terminal
 i) LI 25-26; pharyngeal teeth tend to be molariform
 Rwanda *B. ruasae*
 ii) LI 28-35 (most often 30-34, m = 32)
 DSP, \bar{x} = 16.9; Ab, \bar{x} = 4.3; Pb, \bar{x} = 5.4
 Lakes Victoria, Kivu, Edward and George *B. altianalis*
 iii) LI 26-34 (most often 28-32, m = 29)
 DSP, \bar{x} = 20.1; Ab, \bar{x} = 5.8; Pb, \bar{x} = 6.9
 Blue Nile, Ethiopia, Lakes Rudolf and Baringo, western part of Juba *B. intermedius*

APPENDIX 2

Gazetteer

As I have found it very difficult (and in some cases impossible) to find some of the localities mentioned by authors I have compiled this gazetteer giving as many details as I can find of the collecting sites. Grid references are given where possible. The details of the rivers in Ethiopia come entirely from Zaphiro's notebook. Different cultures occupying an area have sometimes changed the names of lakes or rivers. Where possible all the variants are given.

- Abaya* = Abbaya, the northern lake of a pair of lakes. The name has been loosely applied to either or both lakes in the southern part of the Ethiopian rift valley. G.R. 6°30' N 30°00' E. (See Chiamo, Ganjule, Margharita, Ruspoli.)
- Akaki*, a river, 10-12 m wide, due south of Addis Ababa, it runs from Legadi south to the Hawash.
- Alaba*, a river, some 20 m wide, runs from the Kambata plains to Lake Ganjule. Collecting altitude 6000 feet.
- Arba minch*, tributary of Lake Ganjule.
- Avakubi*, Ituri system (Zaire). G.R. 1°24' N, 27°40' E.
- Awata*, a tributary of the Juba river. G.R. 6°05' N, 39°20' E.
- Barja*, a river, 10 m wide, collecting altitude 4250 feet. It runs from the hills of Sangana and Bako to the Zuja river (Lake Stephanie basin).
- Basso Ebor*, an old name for Lake Stephanie.
- Basso Narok*, an old name for Lake Rudolf.
- Bis(s)an Guarrica*, a tributary of the Sagan river to the south of Lake Abaya.
- Bobandana*, Lake Kivu basin. G.R. 1°38' S, 29°00' E.
- Bushiamé* river, Sankuru system. G.R. 6°00' S, 24°50' E to 8°00' S, 23°00' E.
- Burka*, an affluent of Lake Ganjule.
- Chiamo* (= Ciamo), Lake Ganjule.
- Chirangobo*, an affluent of Lake Kivu.
- Didessa*, a river, some 60 m wide, that runs from Guma to the Blue Nile.
- Elgo*, a fast-flowing river, 15 m wide, collecting altitude 3000 feet, it flows from the Gamu hills eastwards to Lake Abaya.
- Ergino*, a river, 20 m wide, collecting altitude 3000 feet, flows from the Basketo hills northwards to the Omo.
- Errer*, a river in the Webi Shebéli system. G.R. 9°00' N, 42°20' E.
- G. el Narua*, Guasso el Narua. G.R. 0°16' N, 36°18' E.
- G. Nyuki*, Guasso Nyuki, mouth at 0°28' N, 36°08' E (probably a swampy locality).
- Ganda*, a river, 15 m wide, collecting altitude 3000 feet, flows from the hills of Gama to Lake Ganjule.
- Ganjule*, the southern lake of the pair of which the northern lake is Abaya (also called Chiamo, Ruspoli). G.R. 6°50' N, 37°40' E.
- Gato*, a fast flowing river, 15 m wide, which rises in the hills of Gandulla and flows west to the Sagan. Collecting altitude 3700 feet. (Lake Stephanie basin.)
- Gibe*, a fast-flowing stream, 20 m wide, which flows directly south from the plains of Gorombi (altitude 2800 feet) (supposed to be the source of the Omo).
- Gofa*, a river, Hawash system.
- Gombela*. G.R. 10°50' S, 27°50' E.
- Gudar* (= Gudr), a stream flowing north from the Rogge mountains to the Blue Nile. Collecting altitude 3400 feet.
- Hawash*, most collections in this river were made by Zaphiro at Zeluka, altitude 4100 feet.
- Jerrer*, exact locality untraceable. Mount Jerrer is 32 km southwest of Addis Ababa, according to Zaphiro's notebook, the river is therefore apparently in the Webi Shebéli system.

- Juju*, a river, 10 m wide, flowing from the Guma hills to the Blue Nile. Collecting altitude 2000 feet.
- Kabiashyia*, on the Luanza river, an affluent to the northern edge of Lake Mweru.
- Kando*, near Tenke. G.R. $10^{\circ}25' S, 26^{\circ}10' E$.
- Kanséhété*, a river, an affluent of the Luhoho Congo, due west of Lake Kivu.
- Kassam*, a river, Hawash system. G.R. $9^{\circ}05' N, 39^{\circ}35' E$.
- Kibonoto* (= Kibongoto), an affluent of the Sanya river, Pangani system. G.R. $3^{\circ}11' S, 37^{\circ}06' E$.
- Kibwesi*, a river in the Athi system. G.R. $\pm 2^{\circ}25' S, 37^{\circ}56' E$.
- Kiyimbi*, a river, Loama-Lualaba Congo. G.R. $5^{\circ}00' S, 28^{\circ}59' E$.
- Koki*, a river, an affluent of Lake Tanganyika. G.R. $6^{\circ}03' S, 29^{\circ}05' E$.
- Laikipa* (Leikipa), an escarpment. G.R. $0^{\circ}25' N, 36^{\circ}10' E$.
- Loama*, an affluent of the Luhoho Congo, due west of Lake Kivu.
- Luembe*, a river = Cashimo river. G.R. $8^{\circ}00' S, 21^{\circ}35' E$.
- Lufiro*, a river. G.R. $2^{\circ}40' S, 29^{\circ}00' E$.
- Luilu*, a river, Sankuru system. G.R. $7^{\circ}30' S, 23^{\circ}30' E$.
- Lusine*, a river, Rwanda, flows from Lake Mohashi into the Akangaru. G.R. $2^{\circ}30' S$ to $6^{\circ}00' S, 30^{\circ}45' E$.
- Mahembe*, on the Nyawarongo river, Kagera system, Lake Victoria basin. G.R. $\pm 1^{\circ}52' S, 29^{\circ}54' E$.
- Maki*, a fast-flowing stream that originates in the hills of Goraza and flows into Lake Zwai.
- Makindu*, a river. G.R. $2^{\circ}09' S, 37^{\circ}35' E$.
- Malawa*, a river, Lake Victoria basin. G.R. $0^{\circ}40' N, 35^{\circ}30' E$.
- Margarita*, lake = Lake Abaya.
- Metti*, a fast-flowing river, 20 m wide, altitude 3500 feet. Flows from Tulumdimtu northwards to the Gudar river. (Blue Nile.)
- Mkunga* (= Mukungwa), a river, near Ruasa, northwest Rwanda, runs from the southeastern part of Lake Luhondo to the Nyawarongo. G.R. $1^{\circ}35' S, 29^{\circ}40' E$.
- Modjo*, a river, Webi Shebeli system.
- Mogre*, a river, tributary of the Blue Nile.
- Mutamphu*, a river, a tributary of the River Akangaru, Kagera system. Specimens with this locality were collected about 12 km along the road to Shangugu from Butare. G.R. $\pm 2^{\circ}43' S, 29^{\circ}43' E$.
- Mwogo*, an affluent of the Kagera.
- Narok*, a river. G.R. $0^{\circ}32' N, 36^{\circ}52' E$.
- Nyabarongo*, a river in the Luhoho Congo system.
- Nyabugogo*, an affluent of the Lusine river.
- Nyawarongo*, Kagera system.
- Nyundeulu*. G.R. $10^{\circ}58' S, 25^{\circ}50' E$.
- Rugwero*. Lake, Rwanda. G.R. $2^{\circ}25' S, 30^{\circ}20' E$.
- Ruspoli* = Lake Ganjule.
- Sagan*, a fast-flowing stream, 15 m wide, at Wondo (altitude 2800 feet) where most collecting was done. Blue Nile system.
- Sangé*, an affluent of the Ruzizi. G.R. $3^{\circ}04' S, 29^{\circ}08' E$.
- Siré* (= Siri), a stream flowing from the Gamu hills eastwards to Lake Abaya, collecting altitude 3000 feet.
- Suksuki*, a river linking Lake Zwai and Lake Suksuki.
- Tchiatu*, a river, near Luachimo, Upper Kasai region. G.R. $7^{\circ}40' S, 20^{\circ}50' E$.
- Tokwe*, a river, near Bwambe, Uganda.
- Tsavo*, a river. G.R. $2^{\circ}59' S, 38^{\circ}02' E$.
- Tshikapa*, a river, Upper Kasai (Congo) system. G.R. $6^{\circ}28' S, 20^{\circ}48' E$.
- Uaso narok*, a river flowing from the Laikipa escarpment northeastwards to the Uaso Nyiro.
- Urgessa*, a river, 15 m wide, flowing northwest to the Wama river (Blue Nile system).
- Wondinak*, a small stream flowing northwest into the Gibe river (Omo system).

Zeissi, a turbulent stream, about 10 m wide, flowing from the Zeissi hills eastwards to Lake Ganjule. G.R. 1°52' N, 37°29' E.

Zendo, a river, 15 m wide, flowing from the Anko hill eastwards to the Maze river, an affluent of the Omo. Collecting altitude 4300 feet.

Zuga, a river, 30 m wide, running from the hill Marta to Lake Stephanie. Collecting altitude 4200 feet.

APPENDIX 3

Barbus susanae, a replacement name for *Barbus gregorii* Norman.

Barbus gregorii Norman (1923) from China is preoccupied by *Barbus gregorii* Boulenger (1902) from Africa. Fowler (1958) noticed this and proposed *Barbus yunnanensis* to replace *Barbus gregorii* Norman. Fowler had unfortunately overlooked the fact that *Barbus yunnanensis* had already been used by Regan (1904) for a fish from Yunnan, China, the same area as that from which *Barbus gregorii* Norman comes.

I have examined the type of *Barbus yunnanensis* Regan B.M. (N.H.) Reg. No. 1904.1.26 : 78 and the syntypes of *Barbus gregorii* Norman B.M. (N.H.) Reg. Nos. 1923.2.21 : 29-36, and they are very distinct.

I therefore propose *Barbus susanae* to replace *Barbus gregorii* Norman.

Derivation of name : named after my wife.

BOULENGER, G. A., 1902

Description of new fishes from the collection made by Mr E. Degen in Abyssinia. *Ann. Mag. nat. Hist.* (7) 10 : 422.

REGAN, C. T., 1904

A collection of fishes made by Mr J. Graham at Yunan Fu. *Ann. Mag. nat. Hist.* (7) 13 : 191.

NORMAN, J. R., 1923

Three new fishes from Yunan collected by Professor J. W. Gregory, F.R.S. *Ann. Mag. nat. Hist.* (9) 2 : 562.

FOWLER, H. W., 1958

Some new taxonomic names for fish-like vertebrates. *Not. nat.* (310). August 1958 : 12.

APPENDIX 4

A complete list of the registered material examined.

In some cases more specimens were examined than were used in the description of the species, consequently a complete list was deemed advisable.

The Ethiopian *Barbus* spp. from the Stazione Idrobiologia, Rome, do not have any register numbers.

The species are arranged alphabetically and the following code applies :

B.M. (N.H.)	British Museum (Natural History)
C.F.M.	Chicago Field Museum
M.A.C.T.	Musée d'Afrique Centrale, Tervuren
M.H.N.P.	Museum National d'Histoire Naturelle, Paris
M.S.N.G.	Museo Civico di Storia Naturale G. Doria, Genova
P.A.S.	Philadelphia Academy of Natural Sciences, U.S.A.
S.M.F.	Senckenberg Museum, Frankfurt
S.M.N.H.	Stockholm Museum of Natural History
Z.M.B.	Zoologisches Museum an der Humboldt - Universität zu Berlin
Z.M.H.	Zoologisches Staatsinstitut und Zoologisches Museum, Hamburg.

The first paragraph contains the register numbers of the type specimens of the species and of the species now in the synonymy. The following paragraph contains entirely non-typical material.

Barbus acuticeps M.A.C.T. 130313 (holotype); 130310-312; 130314 (paratypes).

M.A.C.T. 91755-6, 92214.

Barbus alluaudi M.H.N.P. 09-586, 09-587 (syntypes).

Barbus altianalis B.M. (N.H.) 1906.9.6:13 (lectotype of *Barbus altianalis altianalis*); 1906.9.7:41 (holotype of *Barbus altianalis eduardianus*); 1904.5.19:13 (holotype of *Barbus altianalis radcliffii*); 1906.5.30:117-121; 1906.9.6:14-15; 1906.9.7:41; 1906.9.7:42-43; 1911.3.3:5; 1929.1.24:84; 1929.1.24:105-108; 1929.1.24:191-192; M.H.N.P. 30-118; 35-153; Z.M.H. 19052.

B.M. (N.H.) 1906.5.30:107-115; 1912.10.15:15-19; 1912.10.31:1; 1925.8.7:1-2; 1928.1.25:12; 1928.5.24:18-25; 1932.6.13:280-289; 1932.6.13:312-320; 1932.6.13:332; 1938.12.6:19; 1957.10.1:1-9; 1962.7.26:1-14; 1965.11.7:7-10; 1966.6.3:192; 1966.9.1:1; 1966.9.1:2-4; 1967.5.17:52-60; 1971.1.5:121-133; 1971.2.19:28-57; 1971.8.31:7-12; 1971.8.31:28-39; M.H.N.P. 35-143, 144; M.A.C.T. 66182; 66183; 92608; 91118-91122; 129096; Z.M.H. 19052.

Barbus bynni B.M. (N.H.) 1907.12.2:1230 (neotype); 1932.6.13:300-303; M.S.N.G. 17333; M.H.N.P. 05-275.

B.M. (N.H.) 1861.9.9:39-43; 1861.9.9:64; 1862.6.17:117-122; 1862.6.17:130-131; 1905.10.26:11; 1907.12.2:1181-1229; 1907.12.2:1231-1251; 1907.12.2:3721-3728; 1908.1.20:111-116; 1908.11.7:1; 1929.1.24:109-112; 1937.4.20:7-9; 1968.7.24:37; 1970.12.15:1; M.S.N.G. 17337; P.A.S. 16710.

Barbus caudovittatus M.A.C.T. 1168 (holotype); B.M. (N.H.) 1901.12.26:26 (paratype); 1919.7.24:7; 1919.7.24:8-9.

B.M. (N.H.) 1920.5.26:75-76; 1936.6.15:643-644; M.A.C.T. 6785; 6786; 6992; 14551; 15410; 15584; 39456; 43823; 44446-44461; 44482; 44483; 44551-44563; 47341; 48504; 48505; 50061-62; 56416; 56417; 61304-63011; 74754; 77407; 78927; 78928; 81618; 81619; 81620; 81622-31; 81632-35; 81637-81656; 81661-81984; 81988; 91117; 92561; 92562; 92563-78; 92608; 94318; 96108-114; 99654; 102024; 121781-826; 124937; 125774-780; 129095; 130067; 130068; 131355; 134956; 134957; 138957; 148829; 148830; 148839; 153485; 160152-163; 160165-67; 164571; 166954.

Barbus ethiopicus B.M. (N.H.) 1971.7.12:1-3.

Barbus gananensis M.S.N.G. 17525 (holotype, not seen by me); M.S.N.G. 17331; 17339; 17341; 17342.

Barbus intermedius S.M.F. 6778 (holotype of *Barbus intermedius intermedius*); B.M. (N.H.) No. 18 in 1932.6.13:191-200 (holotype of *Barbus intermedius australis*); S.M.F. 2586; 2619; 6779; 6786; M.H.N.P. 05-252; 05-257; B.M. (N.H.) 1893.12.2:40-45; 1902.12.13:211-212; 1902.12.13:225-228; 1902.12.13:261-270; 1902.12.13:274-275; 1902.12.13:294; 1902.12.13:295-298; 1902.12.13:303-304; 1902.12.13:305-306; 1902.12.13:309; 1902.12.13:328-331; 1903.11.16:1-7; 1908.1.20:100; 1908.1.20:103-106; 1908.1.20:107-109; 1908.1.20:110; 1908.1.20:131-133; 1908.1.20:170; 1908.1.20:181-183; 1916.1.14:7; 1937.4.20:66.

B.M. (N.H.) 1893.12.2:46-47; 1901.6.24:83-85; 1902.12.13:229; 1902.12.13:231-250; 1902.12.13:277-283; 1902.12.13:284-290; 1902.12.13:308; 1902.12.13:311; 1902.12.13:312-315; 1902.12.13:317-319; 1902.12.13:320-326; 1902.12.13:332-337; 1902.12.13:339; 1902.12.13:357; 1908.1.20:86; 1908.1.20:91-95; 1908.1.20:97-99; 1908.1.20:101-102; 1908.1.20:117-130; 1908.1.20:134-155; 1908.1.20:157-168; 1908.1.20:171-180; 1912.3.22:50-60; 1912.11.11:9-10; 1932.6.13:191-200 (less the holotype of *Barbus intermedius australis*); 1932.11.5:246-60; 1937.4.20:29-37; 1937.4.20:39-60;

1937.4.20 : 65 ; 1959.12.15 : 82-86 ; 1968.7.24 : 3-7 ; 1968.7.24 : 9-17 ; 1968.7.24 : 20-48 ; 1971.8.31 : 15-16 ; P.A.S. 14541 ; 14542.

Barbus longifilis M.H.N.P. 35-150 (lectotype) ; 35-145 - 149 ; 35-151 ; 35-152. M.H.N.P. 35-67 ; M.A.C.T. 42934.

Barbus macrolepis Z.M.H. H331 (lectotype).

B.M. (N.H.) 1909.2.25 : 8 ; 1922.4.18 : 13 ; 1971.6.22 : 131-134. 1972-11.28 : 9-12.

Barbus mariae holotype not seen.

B.M. (N.H.) 1936.12.22 : 35-39 ; 1937.6.4 : 16.

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Barbus microterolepis B.M. (N.H.) 1902.12.13 : 220 (holotype).

Barbus mirabilis Z.M.B. 19059 (holotype).

Barbus oxyrhynchus Z.M.H. H339 (lectotype) ; B.M. (N.H.) 1893.12.2 : 24-29 ; 1893.12.2 : 32-34 ; 1893.12.2 : 37-39 ; 1902.5.26 : 25-28 ; 1902.5.26 : 35-38 ; 1906.8.25 : 7-9 ; M.H.N.P. 26-285 ; S.M.N.H. 9238 ; F.M.C. 6108 ; 6109 ; Z.M.H. 340.

B.M. (N.H.) 1893.12.2 : 30 ; 1893.12.2 : 35 ; 1902.5.26 : 29-34 ; 1904.1.30 : 5-18 ; 1904.10.10 : 2-4 ; 1904.12.23 : 48-49 ; 1906.8.25 : 6 ; 1906.8.25 : 10-16 ; 1908.9.17 : 8-12 ; 1909.11.15 : 43-47 ; 1914.9.21 : 4 ; 1915.12.2 : 2-20 ; 1936.12.22 : 2 ; 1936.12.22 : 30-34 ; 1937.12.11 : 1-4 ; 1937.6.4 : 15 ; 1959.12.15 : 81 ; 1965.11.1 : 7-12 ; 1966.6.3 : 252 ; 1969.3.24 : 10 ; 1969.3.24 : 44-50 ; 1971.5.10 : 55 ; 1971.8.12 : 2-6 ; F.M.C. 6110 ; M.A.C.T. 47341 ; S.M.N.H. 8061 ;

Barbus pagenstecheri Z.M.H. H.342 (lectotype), H.341 (paralectotype).

Barbus paucisquamatus M.H.N.P. 35-76 (lectotype).

M.H.N.P. 35-77 ; 35-78 ; 35-153 ; 35-154 ; 35-118 (3 specimens) ; M.A.C.T. 42932 ; 130145 ; 130146.

Barbus platyrhinus B.M. (N.H.) 1906.9.6 : 12 (holotype).

M.A.C.T. 89789-92 ; 130658-60.

Barbus ruasae Z.M.B. 19053 (lectotype, one of two specimens).

M.A.C.T. 91755 ; 91756 ; 92214.

Barbus somereni B.M. (N.H.) 1911.7.26 : 1 (holotype) ; M.A.C.T. 46963-65.

B.M. (N.H.) 1969.3.3 : 13-14 ; 1971.1.5 : 96-99 ; 1971.1.5 : 100-117 ; 1971.1.5 : 120 ; 1971.1.5 : 145 ; 1971.2.19 : 26-27 ; 1971.8.31 : 13-14 ; 1971.10.18 : 1-5 ; M.A.C.T. 46952-62 ; 46966-47339 ; 47342 ; 55788-792 ; 56456-478 ; 56480-91 ; 71781-82 ; 73157-73162 ; 87692-695 ; 87696-698 ; 94221-232 ; 92579-89 ; 92591-92607 ; 93356-377 ; 129108.

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M.A.C.T. 81945 ; 81985 ; 122295 ; 138958-959.

Barbus trachypterus M.A.C.T. 81621 (holotype).

M.A.C.T. 129097-100 ; 165254-256.

Barbus tropidolepis B.M. (N.H.) 1906.9.6 : 19-21 (the smallest specimen is the lectotype).

B.M. (N.H.) 1906.9.8 : 50-52 ; 1920.5.25 : 38-46 ; 1936.6.15 : 568-629 ; 1955.12.20 : 720-731 ; 1955.12.20 : 733-815 ; 1955.12.20 : 873 ; 1955.12.20 : 888 ; 1955.12.20 : 1169-1171.

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The generic name *Barbus* has been omitted from this list. Where the genus is not *Barbus* it is *Varicorhinus* and is symbolized by *V*.

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